April 7, 2000

Ms. Elizabeth Estill
Regional Forester
U.S. Forest Service, Southern Region
1720 Peachtree Road, NW.
Atlanta, Georgia 30367-9102

Dear Ms. Estill:

Subject: Biological Assessment on the Effects of Implementing the Nantahala and Pisgah National Forests Land and Resource Management Plan, Amendment Five, on the Indiana Bat (*Myotis sodalis*)

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion based on our review of the subject biological assessment and its effect on the Indiana bat in accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*). We received your October 18, 1999, request for formal consultation on October 18, 1999.

This biological opinion is based on information provided in the October 18, 1999, biological assessment, supplemental information to the biological assessment (requested on December 15, 1999, received January 13, 2000), other available literature, personal communications with experts on the federally endangered Indiana bat (*Myotis sodalis*), and other sources of information. A complete administrative record of this consultation is on file at this office.

CONSULTATION HISTORY

In 1994 the U.S. Forest Service (USFS) completed a biological assessment (BA) on the Nantahala and Pisgah National Forests Land and Resource Management Plan (Forest Plan) for federally proposed, threatened, endangered, and candidate species, including the Indiana bat. The Service concurred with

the USFS's determination of "not likely to adversely affect"[1] for the Forest Plan (Service 1994). The provisions of section 7 of the Act were met. The "not likely to adversely affect" determination did not require formal consultation with the Service.

Until 1995, bat experts with most national forests in the Southeastern United States believed that southern forests (that did not have hibernacula) were not used by Indiana bats, particularly as summer maternity habitat. However, in 1994 and 1995, reproductive female Indiana bats were captured between mid-June and September on the Morehead Ranger District, Daniel Boone National Forest, Kentucky, providing the first indication that southern forests may be used as summer maternity habitat by Indiana bats. Because of these new records, southern forests near winter hibernacula sites began reexamining the likelihood of having maternity colonies during summer months; many forests initiated summer mist-net surveys of likely habitat.

The USFS began these mist-net surveys, initially focusing on those portions of the national forests having the greatest likelihood of being occupied by reproductively active bats. Factors used to determine the likelihood of occurrence included habitat characteristics and the proximity of USFS land to recent or historical hibernation records. Mist-net surveys were initiated on the Nantahala National Forest in late May 1999.

On July 25, 1999, two Indiana bats were netted in the upper Santeetlah Creek drainage in Graham County, North Carolina. A postlactating adult female and a juvenile male were captured and banded. A radio transmitter was attached to the female, and both bats were released at the capture site. On July 26, 1999, research personnel found the adult bat's roost site.

On the evening of July 26, 1999, a third Indiana bat, a juvenile female, was netted less than 100 yards from the initial capture site. All three bats were captured within 25 miles (mi.) of White Oak Blowhole Cave (a Priority II Indiana bat hibernaculum) in Tennessee. On July 27 and 28, 1999, additional field work verified the presence of a summer maternity colony of up to 28 bats roosting in a large, dead Canadian hemlock. The capture of these Indiana bats on the Nantahala National Forest represents the first known summer maternity activity in western North Carolina.

Following the discovery of these Indiana bats in Graham County, the USFS began informal consultation with the Service. Based on the new record, the Service advised the USFS that the species may be present anywhere in Graham County and, because of similar habitat, in adjacent counties (Macon, Swain, and Cherokee), and that the cutting of trees as small as 3.1 inches (in.) in diameter could impact the Indiana bat (Romme *et al*. 1995). The USFS evaluated these risks and suspended activities involving the cutting of trees in the four-county area until the effects of ongoing and proposed actions could be determined. The USFS determined that the recent discovery of the Indiana bat maternity colony required a review of the effects of their proposed and ongoing projects on the Nantahala National Forest in Graham County and the adjoining counties.

[1] The Service concurred with the determination because the Service considered the Indiana bat as ". . . not likely to occur on the Forest" (Service 1992)

On September 7, 1999, the Service received an Amendment to the Biological Evaluations for the Independence Day Storm Project, Barker/Belding Timber Sale, Poison Cove Timber Sale, and Tatham Gap Timber Sale, on the Cheoah Ranger District, Nantahala National Forest, Graham County, North Carolina, and Big Choga Timber Sale, on the Wayah Ranger District, Nantahala National Forest, Macon County, North Carolina, in which the USFS determined that the subject timber sales would not adversely affect the endangered Indiana bat. These sales were part of those initially suspended when the Indiana bat was discovered on the Nantahala National Forest.

The Service agreed with the determination in the amended biological evaluations, which was based on additional mist-netting and habitat evaluations, that the Indiana bat does not occur or is only present at undetectably low levels in those project areas. The Service also agreed that, given the information provided in the biological evaluations, should the species be present at an undetectably low level or begin using the area in the future, an abundance of suitable habitat will be available after the subject projects are completed. Therefore, the Service concurred with the USFS's determination that the projects, as described, are not likely to adversely affect the Indiana bat (Service 1999a).

On September 16, 1999, the USFS amended the biological evaluation for the Tuni Gap Road construction project on the Wayah Ranger District, Nantahala National Forest, Macon County, North Carolina, and determined that the subject project would not adversely affect the endangered Indiana bat. Because of the lack of snags (i.e., dead, standing trees) in the immediate project area and the quantity of suitable habitat immediately outside the project area, the Service concurred with the USFS's "not likely to adversely affect" determination (Service 1999b).

On September 16, 1999, the Service also received an amendment to the biological evaluation for the Martin Easement (Whitner Bend Road), Tusquitee Ranger District, Nantahala National Forest, Cherokee County, North Carolina, in which the USFS determined that the subject project would not adversely affect the endangered Indiana bat. Because there are only a few snags and only a handful of large trees in the project area, most of which are species not likely to provide suitable roosting habitat, the probability of an Indiana bat using the area or being affected by the proposed project is small. Further, the direct loss of 1.3 acres (ac.) of forested habitat and possible indirect losses to home construction (though potentially suitable as Indiana bat habitat in the future) are not likely to affect Indiana bat use in the local area, given the thousands of acres of suitable habitat surrounding the project area. Therefore, the Service concurred with the USFS's determination that the project, as described, was not likely to adversely affect the Indiana bat (Service 1999c).

On September 30, 1999, the USFS amended the biological evaluation for the U.S. 19/74 turn lane and bridge replacement, Wayah Ranger District, Nantahala National Forest, Swain County, North Carolina, and determined that the subject project would not adversely affect the endangered Indiana bat. Because of the lack of snags in the immediate project area, the fact that tree removal would occur while the bats were hibernating, and the abundance of suitable habitat immediately outside the project area, the Service concurred with the "not likely to adversely affect" determination (Service 1999d).

On October 18, 1999, the USFS completed the subject BA on the effects of implementing the Forest Plan on the Indiana bat. As stated in the BA, "This new occurrence information, as well as a refinement of new knowledge of this species' habitat requirements, prompted the need to reexamine the potential effects of continued implementation of the existing Forest Plan, as amended. The verification of a summer maternity colony on the Nantahala National Forest increases the likelihood of other summer maternity colonies being present throughout the national forests." The following biological opinion is the Service's analysis of this BA.

On October 19, 1999, the USFS amended the biological evaluation for the construction of a drain field to service a flush toilet in the Ferebee Memorial Picnic Area, Wayah Ranger District, Nantahala National Forest, Swain County, North Carolina, and determined that the subject project would not adversely affect the endangered Indiana bat. Because of the lack of snags in the immediate project area, the timing of tree removal, and the quantity of suitable habitat immediately outside the project area, the Service concurred with the USFS's "not likely to adversely affect" determination (Service 1999e).

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

As defined in the Service's section 7 regulations (50 CFR 402.02), "action" means "all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies in the United States or upon the high seas." The "action area" is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." The direct and indirect effects of the actions and activities must be considered in conjunction with the effects of other past and present Federal, State, or private activities, as well as the cumulative effects of reasonably certain future State or private activities within the action area. This biological opinion (Opinion) addresses only those actions for which the Service believes adverse effects may occur. In their BA, the USFS outlined those activities in the Forest Plan (and projects predicated upon it) that would affect the Indiana bat. This Opinion addresses whether continued implementation of the Land and Resource Management Plan, Amendment Five, on the Nantahala and Pisgah National Forests (NPNFs) is likely to jeopardize the continued existence of the Indiana bat.

The proposed action, as defined in the BA, is "the continued implementation of the Nantahala and Pisgah Land and Resource Management Plan, Amendment Five, and projects predicated upon it." The proposed action includes likely future site-specific projects. The purpose of the USFS's *programmatic* BA is to document the potential effects of the continued implementation of the existing Forest Plan for the NPNFs, specifically those measures that deal with the management and monitoring of populations and habitat of the federally endangered Indiana bat.

The stated objectives of the BA are to:

(1) Comply with the requirements of the Act so that actions by Federal agencies (in this case the NPNFs) do not jeopardize the existence of this species or adversely modify its critical habitat;

(2) Assess the implementation of the current Forest Plan, which describes the USFS's likely future actions and standards and guidelines and the effects implementation will have on the federally endangered Indiana bat;

(3) Document standards and guidelines implemented on the NPNFs that benefit this species; and

(4) Provide biological input to ensure USFS compliance with the National Forest Management Act, Forest Service Manual 2670, and the Act.

Action Area

The action area for this opinion is the NPNFs in North Carolina. The NPNFs lie within the Blue Ridge Province of the Appalachian Mountains. Elevations range from about 1,000 feet (ft.) to more than 6,000 ft. above sea level. The Appalachian Mountains were formed by many complex geologic processes over the last 1.8 billion years. The Blue Ridge Mountains are primarily comprised of igneous and metamorphic rock types. Soils are dominated by Ochrepts and Udults and are generally moderately deep and of medium texture. Soils receive adequate moisture for growth of vegetation throughout the year.

There are five active mines and leases on the NPNFs, ranging from 3-158 ac. in size. There are no current oil, gas, geothermal, or other energy mineral mines or leases on or within the periphery of the NPNFs.

Water

The region has a high density of small to medium-sized perennial streams and rivers. About 4,431 mi. of perennial streams and about 300 mi. of cool- and warm-water rivers occur on the NPNFs. The largest rivers include the French Broad and Little Tennessee rivers. No natural lakes exist; however, there are about 36,000 ac. of manmade lakes and reservoirs. Of this area, approximately 35,900 ac. are reservoirs maintained by other agencies and private companies for flood control and/or hydroelectric power generation.

Average precipitation ranges from 31-50 in. in most of the action area but is higher on the highest mountain peaks. The eastern three ranger districts average the lowest annual rainfall amounts across the NPNFs. Along parts of the southern Blue Ridge escarpment bordering the Southern Appalachian Piedmont Section, rainfall averages over 80 in. Mean annual temperature is 50 -62 F and ranges from 38 F in January to 76 F in July.

Disturbance Regimes

Fire, wind, ice, and precipitation are the principal causes of natural disturbance. Indications are that Native Americans used fire for many purposes, especially at low elevations in the drier intermountain basin. Lightning-caused fire is more predominant along the eastern sections of the Blue Ridge Mountains, and on dry xeric aspects dominated by yellow pine and oaks. Although tornadoes are uncommon, localized microbursts of intense winds have the potential to cause small patches of trees to be uprooted occasionally in the area. Winter ice storms are common at mid- to high elevations and can cause extensive damage to tree crowns. The American chestnut blight caused broad-scale disturbance and conversion of the original tree species composition to more oak-dominated composition. The gypsy moth has affected localized sections of the NPNFs. The potential for major gypsy moth defoliation is high due to the predominance of oak species in forested stands. Other forest pests threaten the American hemlock, flowering dogwood, Fraser fir, butternut, and other important forest species.

Vegetation

Vegetation in the area consists of Appalachian oak forest, southeastern spruce-fir forest, and northern hardwoods (McNabb and Avers 1994). The dominant vegetation is montane, cold-deciduous, and broad-leaved forest dominated by the genus *Quercus*. Black (*Q. velutina*), white (*Q. alba*), and chestnut oak (*Q. montana*) dominate the drier mountain slopes, with pitch pine (*Pinus rigida*) representing a major component along ridge tops. Mesophytic species, such as yellow poplar (*Liriodendron tulipifera*), red maple (*Acer rubrum*), northern red oak (*Q. rubra*), and sweet birch (*Betula lenta*), dominate the moister valley sites and slopes. Hardwood-pine cover types, consisting of scarlet (*Q. coccinea*), white, blackjack (*Q. marilandica*), and post oak (*Q. stellata*) and shortleaf (*P. echinata*) and Virginia pine (*P. virginiana*), are dominant in the intermontane basins. Table mountain pine (*P. pungens*) is common on xeric ridge tops, where fire most likely was historically more frequent. Mesic sites at higher elevations (more than 4,500 ft.) are commonly occupied by northern hardwoods such as basswood (*Tilia* sp.), sugar maple *(Acer saccharum*), and buckeye (*Aesculus* sp.), with northern red oak more dominant on drier sites. Red spruce (*Picea rubra*) and Fraser fir (*Abies fraseri*) can often be found at altitudes above 5,000 ft.

The USFS used their Forest Continuous Information of Stand Condition (CISC) database for the NPNFs to group forest habitats into six major forest groups (Table 1 and Appendix D). The Upland Hardwood Group occupies the greatest acreage on the NPNFs (45.6% of total forest acreage and 47.9% of forested acreage). Hardwood-dominated forest types comprise more than 83% of forested acreage on the NPNFs (805,012 ac.).

Table 1. Composition of Forest Groupings on the Nantahala and Pisgah National Forests (1999).

Forest Groups	Acres	Percent Composition	Percent of Forest
Conifer	83,782	8.2	8.6
White Pine-Hardwood	43,556	4.3	4.5
Yellow Pine-Hardwood	37,702	3.7	3.9
Cove Hardwood	289,442	28.5	29.8
Upland Hardwood	464,156	45.6	47.9
Northern Hardwood	51,414	5.0	5.3

Non-Forest	25,231	2.3	-
Other Uninventoried	23,425	2.3	-

For both forests, approximately 88% of the forested acreage is more than 40 years old, with 65% equal to or greater than 70 years. More than 18% of forested acres are over 100 years old. For hardwood-dominated forest types, more than 76% of these forest types are greater than 40 years old, and 59% are over 70 years old (Table 2).

Table 2. Forest Age-class Distribution (1999) (percent of each forest group total).

Age-Class	Conifer	White Pine-Hardwood	Yellow Pine-Hardwood	Cove Hardwood	Upland Hardwood	Northern Hardwood	Total
0-10 years	6.0	5.3	2.0	2.2	1.4	0.7	2.2
11-39 years	35.8	19.1	6.1	8.0	5.8	5.7	9.6
40-69 years	11.9	19.0	17.3	28.3	14.9	34.2	19.9
70-99 years	34.5	43.1	52.3	53.4	52.8	38.4	50.2
100+ years	11.8	13.5	22.3	8.1	25.2	21.1	18.1

Of the approximately 1,025,000 ac. of national forest land administered by the NPNFs, roughly 71% (730,328 ac.) are classified as unsuitable for commercial timber production (Pages E-10 and E-11 of the Forest Plan).

This Opinion addresses a variety of management directions and associated activities that are planned, funded, executed, or permitted by the USFS on the NPNFs. These activities are implemented in accordance with the provisions contained in the Forest Plan. The Forest Plan is a general programmatic planning document that provides management goals, objectives, and standards and guidelines under which project-level activities (e.g., timber sales, wildlife habitat management, road construction, special uses, etc.) may be planned and implemented to carry out the management direction of the NPNFs. Additional management direction and guidelines are included in the Forest Plan for specific management areas. Land-use allocations are made and outputs are projected based on the direction established in the Forest Plan. All project-level activities undergo National Environmental Policy Act review by appropriate USFS personnel when proposed, as well as an assessment of project effects on federally listed species in compliance with section 7 of the Act. The Forest Plan establishes multiple-use management area prescriptions (including associated standards and guidelines) for future decision making that are adjustable (via monitoring and evaluation) by amendment and revision.

The BA did not contemplate or assess North Carolina Department of Transportation/Federal Highway Administration activities on the NPNFs. These activities are not included in this Opinion and will be subject to separate consultation(s) pursuant to section 7 of the Act. In addition, USFS activities proposed at levels higher than those projected in the BA (see Table 3) will require further consultation with the Service.

Management Actions: Types and Amounts of Activities

There are many ongoing and planned activities on the NPNFs that could affect Indiana bats or their habitat. The BA details the expected management actions, as described below, and the anticipated levels of activity (summarized in Table 3).

Prescribed Fire - Fire is prescribed to create and maintain desired vegetative composition (for scenic vistas, for wildlife habitat, to reduce fire hazards, and to control forest pests) and to accomplish other forest management objectives such as site preparation. Prescribed burns for wildlife generally fall into two categories: (1) burning existing wildlife openings to help maintain early successional habitat (typically grass fires conducted in the late winter or early spring) and (2) burning understory in a forested area, usually between the fall and early spring, to create or maintain areas with open or reduced understory conditions.

Trail Construction - New trails are built to accommodate a variety of uses and experience levels while complementing forestwide and management area objectives. The use of these trails could include hiking, horseback riding, mountain biking, and off-road vehicles.

Recreation Site Construction - Construction of new recreational sites or support facilities at new or existing recreational sites.

Facilities - Construction of or additions to administrative buildings or support facilities at USFS offices and work centers.

Regeneration by Selection Method - Regeneration occurs in small openings large enough to provide conditions necessary to regenerate species that are shade intolerant or intermediate in shade tolerance. In the Appalachians, the diameter of the group opening is defined as one and a half to two times the mature tree height for the stand. This usually results in openings of 1/4-1 ac., depending on the desired species, tree height, and topography. The resulting stand structure will be uneven-aged, with a mosaic of age-class groups. Most often, regeneration will be from sprouts, seedlings or advanced reproduction. To eliminate competition with the new age-class, site preparation may include cutting down competing vegetation or treating it with herbicides. Both methods may be used either before or after the regeneration cut.

Table 3. Types and Amounts of Activities on the Nantahala and Pisgah National Forests (from BA).

ACTIVITIES	Estimated in the Nantahala and Pisgah National Forest Plan (Annual Average)	Estimated Amount Implemented 1994-1999 (Annual Average)	Estimated for Implementation 2000-2004 (Annual Average)
Prescribed Fire	Fuel Reduction 1,000 acres (ac.) Wildlife Burns (not estimated)	Fuel Reduction 947 ac. Wildlife Burns 250 ac.	Fuel Reduction 1,000-5,000 ac. Wildlife Burns 250-500 ac.
Trail Construction	24 miles (mi.)	17 mi.	20-25 mi.

	29 ac.	21 ac.	24-30 ac.
Recreation Site Construction	No estimate	5 ac.	5-10 ac.
Facilities	No estimate	<1 ac.	<1 ac.
Regeneration by Selection Method	500 ac.	149 ac.	150-500 ac.
Regeneration by Even-aged Methods	235 ac.	Clearcut 120 ac. Shelterwood 67 ac.	Clearcut 100-135 ac. Shelterwood 50-100 ac.
Regeneration by Two Aged Method	2,532 ac.	603 ac.	600-2,500 ac.
Timber Harvesting for Salvage and Other Purposes	No estimate	601 ac.	250-600 ac.
Thinning	No estimate	537 ac.	500-1,000 ac.
Road Construction	17 mi. 52 ac.	3.7 mi. 18 ac.	3-17 mi. 15-52 ac.
Road Reconstruction	13 mi. 42 ac.	35 mi. 42 ac.	35-45 mi. 42-55 ac.
Road Decommissioning	No estimate	5 mi. 1 ac.	20-30 mi. 4-6 ac.
Wildlife Openings Constructed	No estimate		5-10 ac.
Landline Location and Surveying	105 mi. 64 ac.	20 mi. 12 ac.	15-25 mi. 9-15 ac.
Road Easements	No estimate		10-30 ac.
Special Use Permits	No estimate	120 ac.	100-150 ac.
Timber Forest Products Permits	No estimate		100-200 ac.

Regeneration by Even-aged Methods

Clearcut - A method of regenerating stands in which new production develops in fully exposed environmental conditions after removal of most or all of the existing trees. Reproduction may originate naturally from seedlings, seedling sprouts, and sprouts from stumps and roots. Reproduction may also be introduced artificially by planting or direct seeding. The new stand originating on a clearcut area is even-aged regardless of the age structure before clearcutting.

Shelterwood - In this regeneration method, the stand is removed in two or more cuts, and the new stand is established through natural or artificial reproduction before the overstory is removed. The overstory is removed within 10-20 years (normally within one-fifth of the rotation age). The result is an even-aged stand with a structure and composition similar to the clearcut method. Site preparation may include the control of competing vegetation by cutting, treating with herbicides, or combining the two methods, depending on the site-specific objectives and needs.

Regeneration by Two-aged Method - The mature stand is partially cut and a new age-class is established either by natural or artificial methods. The residual overstory is left in place until mid-rotation of the new stand or later (40+ years). The overstory often remains until the new age-class

reaches rotation age. With the development and growth of the new stand in the understory, along with the continued growth of the overstory, the stand takes on a two-aged structure.

Timber Harvest for Salvage and Other Purposes - Timber is salvaged to recover the value from timber damaged from weather and insect and disease infestations. Typically in the mountains, weather damage is a result of high-wind events, ice storms, and snowstorms. Insect infestations include southern pine beetle, other boring insects, and gypsy moth. Disease infestations include oak decline and root diseases. Other activities include the clearing of road rights-of-way and the removal of the overstory in shelterwood harvests.

Thinning - A timber harvest method to reduce stand density in immature stands, primarily to recover potential mortality and/or to improve the growth of the residual trees. Thinning operations may be commercial or noncommercial.

Road Construction - Most of the roads constructed on the NPNFs are constructed to the lowest traffic service level with a clearing width of 25 ft. or less. Roads are constructed primarily to support timber harvest operations. New roads may remain open, or be closed to the public, depending on the open road density requirements and the management objectives for an area.

Road Reconstruction - Road reconstruction involves bringing old roads up to current standards that meet designated management objectives. Activities may include tree removal, reshaping and/or widening, culvert replacement, and placement of gravel.

Road Decommissioning - Roads that are being permanently closed and revegetated.

Wildlife Opening Construction - Wildlife openings are generally constructed to provide early successional habitat (permanent grass/forb) in areas lacking such habitat. Openings are beneficial to many wildlife species, such as Neotropical migratory birds, butterflies and other insects, small mammals, birds of prey, white-tailed deer, and eastern wild turkey. Most openings are less than 5 ac. in size, with a majority averaging about 1 ac. Wildlife openings are usually constructed by cutting trees in an area, clearing the area of stumps and debris, and planting the area with a seed mixture desirable for wildlife purposes. Wildlife openings are often constructed in areas previously used as log landings in timber sales.

Landline Location/Surveying - Boundary line location and surveying is done to relocate existing lines that are no longer visible and to mark new lines on recently acquired property. This work is necessary to avoid trespasses and to protect resources on national forest land. The work is usually accomplished in the fall and winter, during leaf-off season, when lines are easier to find. Crews normally work in a 3- to 5-ft corridor in which they may cut underbrush and small trees (generally no greater than 6 in. in diameter at breast height [dbh]). Boundary lines are surveyed using surveying instruments, and the lines are marked by blazing trees and posting aluminum signs. Boundary corners are marked by driving 1-in aluminum poles into the ground and capping them with a surveying monument about 6 in. above the ground.

Road Easements - Road easements are granted across USFS land to access private property in cases where the only access is across public land or in cases where access across USFS property is in the best interest of the government.

Special Use Permits - These permits are granted across USFS land to allow individuals or private companies to use Federal land.. These activities include power line rights-of-way, seed orchards, parking areas, and other uses.

Timber Forest Products Permits - These permits are issued to individuals for the collection of forest products, such as locust poles, firewood, and small amounts of timber.

Other Activities That Could Potentially Affect Indiana Bat Habitat

Land Exchanges - The USFS exchanges land within its proclamation boundaries to provide or improve protection within a wilderness, protection of Wild and Scenic River corridors, protection of the Appalachian Trail and its corridor, access opportunities (administrative and public), wildlife and fish management opportunities, recreation management opportunities, timber resource management, efficiency of management, and protection of ecologically significant areas. The NPNF's land exchange program involves 100-2,000 ac. per year. Over the past 5 years, the NPNFs exchanged an average of 450 ac. per year and acquired 625 ac. per year.

Land Acquisitions - The USFS purchases land for the same reasons discussed for land exchanges. The USFS can only purchase land outright under special authorizations such as Land and Water Conservation Funds or other specially designated funds. Land acquisitions are averaging about 550 ac. per year. Because land exchanges and acquisitions involve different areas and circumstances unique to each transaction, the effects of such exchanges and acquisitions on Indiana bat habitat will be evaluated on a site-specific basis.

The Nantahala and Pisgah Land and Resource Management Plan

The decision to implement the Forest Plan was approved in 1987. In 1989, the Chief of the Forest Service remanded part of the 1987 Forest Plan for further analysis. The reanalysis began in 1989, culminating in the current Forest Plan (Amendment Five) in 1994. The existing Forest Plan was developed after extensive involvement and review by other Federal agencies, State agencies, private conservation groups, and the public. The current Forest Plan deviates from the traditional compartmentalized approach, relying instead on a more holistic, integrated approach.

The Forest Plan allocates areas to specific land units called "management areas," with each management area established to meet specific long-term management objectives, associated resource outputs, and desired conditions. Management areas have been established to achieve different desired conditions, to emphasize different activities, permit different uses of the NPNFs, and to emphasize differing wildlife species and landscape features. The NPNFs have been allocated to 18 management areas (Table 4 and Pages III-54 to III-56 in the Forest Plan). Prescriptions have been established to provide direction to achieve specific management area goals and objectives. An overriding goal in the allocation of management areas was to use an ecosystem management approach that provides for a full range of public uses and functioning ecosystems, from old-growth to early successional habitats.

Standards and guidelines are included, both at the forest level as well as at the management area level, to ensure that activities are implemented in a manner consistent with forest goals and objectives. The Forest Plan emphasizes standards and guidelines that work toward maintaining and/or enhancing plant and animal diversity and viability. Amendment Five supplements the forest management objectives, with specific direction for threatened and endangered species.

CURRENT USFS INDIANA BAT CONSERVATION MEASURES

Conservation measures represent actions pledged in the project description that the action agency will implement to further the recovery of the species under review. Such measures should be closely related to the action and should be achievable within the authority of the action agency. The beneficial effects of conservation measures are taken into consideration in the Service's conclusion of a jeopardy versus a nonjeopardy opinion and in the analysis of incidental take. However, such measures must minimize impacts to listed species within the action area in order to be factored into the Service's analyses. The proposed actions subject to consultation on the NPNFs also include ongoing conservation measures implemented through standards and guides outlined in the Forest Plan to reduce or minimize the adverse effects of actions on the Indiana bat.

Table 4. Nantahala and Pisgah National Forest Acreage by Management Area.	
Management Area	**Acreage**
1. B. Emphasize a sustainable supply of timber and provide motorized access into the forest for traditional forest uses.	38,498
2. A. Provides for visually pleasing scenery. Timber production is permitted but is modified to meet visual quality objectives. Roads are generally open. C. Provides for visually pleasing scenery. Not suitable for timber production. Roads are generally open.	40,642
3. B. Emphasize a sustainable supply of timber but with few open roads and limited disturbance associated with motorized vehicles.	232,873
4. A. Permits timber production that is modified to emphasize visual quality and wildlife habitat. C. Scenic areas and older forests. D. Wildlife habitat for species requiring older forests.	55,604 179,992 160,080
5. Roadless Areas.	119,685
6. Wilderness Study Areas.	8,419
7. Wilderness.	66,550
8. Experimental Forests.	12,520
9. Roan Mountain.	7,900
10. Research Natural Areas.	1,460
11. Cradle of Forestry.	6,540
12. Developed Recreation Areas.	3,030
13. Special Interest Areas.	10,370
14. Appalachian Trail and Corridor.	12,450
15. Wild and Scenic Rivers Corridors.	2,050
16. Administrative Facilities Sites.	1,260
17. Balds.	3,880
18. Riparian Areas.	101,530

Although the Forest Plan indicates "The Indiana bat uses summer foraging and maternity habitats across the Forests," there are no standards and guidelines designed specifically to protect, maintain, or enhance summer or winter Indiana bat habitat or prevent impacts to Indiana bats roosting in trees[2]. However, impacts to Indiana bats resulting from the implementation of various land management activities (e.g., timber harvesting), may be coincidentally reduced through forestwide standards and/or the implementation of standards and guidelines specific to those activities. For example, impacts to potential Indiana bat roosting and foraging habitat may be minimized by carrying out the "snag and den tree retention" standards, "riparian filter strip" standards, and guidelines for timber harvesting (Appendix A).

Forestwide standards may minimize negative impacts to, or, in some cases, potentially improve Indiana bat habitat. These standards and guidelines were developed to meet specific resource objectives, to serve as mitigation measures, and to provide for population viability for native wildlife species. The

[2] Note that the Service believed the Indiana bat did not occur on the NPNFs at the time the Forest Plan was reviewed. Therefore, the Service did not object to, or deem inadequate, measures the USFS implemented to protect the Indiana bat (Service 1992, 1994).

standards and guidelines that likely pertain to the Indiana bat are listed in Appendix A, referenced with Forest Plan page numbers.

STATUS OF THE SPECIES/CRITICAL HABITAT

Federal Status

The Indiana bat was listed as an endangered species on March 11, 1967 (32 FR 4001), under the Endangered Species Preservation Act of October 15, 1966 (80 Stat. 926; 16 U.S.C. 668aa(c)). It is currently included as an endangered species under the Endangered Species Act of 1973, as amended. Critical habitat was designated on September 24, 1976 (41 FR 41914), and included caves in Kentucky, Tennessee, Illinois, Indiana, Missouri, and West Virginia.

Based on censuses taken at hibernacula between 1995 and 1997, the total, known Indiana bat population was estimated to number about 353,000 bats; this represents a decline of about 60% since surveys began in the 1960s. Although the 1997 data were incomplete, the trend continues downward. The most severe declines were in Kentucky and Missouri, where 180,000 and 250,000 bats were lost, respectively, between 1960 and 1997. In Indiana, however, populations dropped by 50,000 between the earliest censuses and 1980 but have rebounded to former levels in recent years. Currently, half the known Indiana bats winter in Indiana.

The Service (1999) completed an agency draft of a revised recovery plan for the Indiana bat. The recovery plan is being revised to: (1) update information on the life history and ecology of the Indiana bat, especially information on summer ecology gathered since 1983; (2) highlight the continued and accelerated decline of the species; (3) continue site protection and monitoring efforts at hibernacula; and (4) focus new recovery efforts toward research in determining the factor or factors causing population declines. The main recovery actions identified in the revised recovery plan are to:

Conduct research necessary for the survival and recovery of the Indiana bat, including studies on ecology and life history; summer habitat requirements; genetics; potential chemical contamination; and assessments of temperature profiles and hibernation microclimates of major hibernacula.

Obtain information on population distribution, status, and trends.

Protect and maintain Indiana bat populations.

Provide information and technical assistance outreach.

Coordinate and implement the conservation and recovery of the Indiana bat.

Indiana Bat Biology

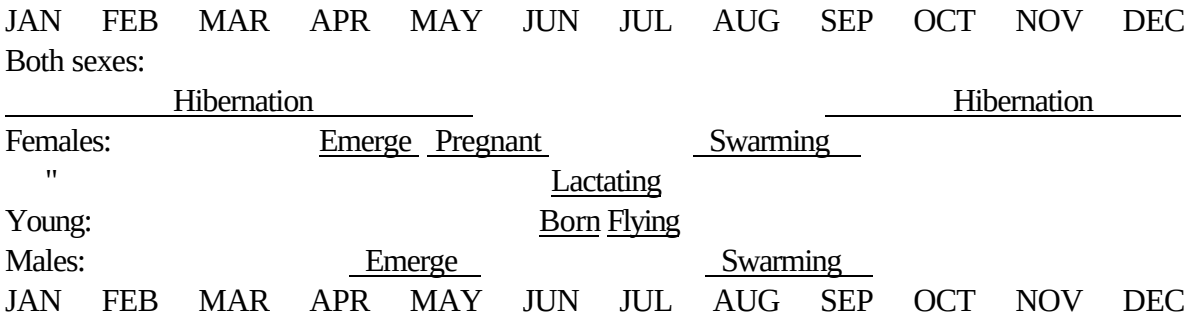
Description

The Indiana bat is a medium-sized monotypic species (no subspecies) of the genus *Myotis*. It is migratory and occurs over much of the eastern half of the United States. Head and body length ranges from 1 5/8-1 7/8 in., and forearm length ranges from 1 3/8-1 5/8 in. (Service 1983). This species is similar in appearance to both the little brown bat *(M. lucifugus*) and the northern long-eared bat (*M. septentrionalis*) but has several distinct morphological characteristics (Barbour and Davis 1969, Hall 1981).

General Life History Chronology

Typically, Indiana bats hibernate from October through April (see "Hibernation"), depending on local weather conditions (see Figure 1 for a depiction of the annual cycle). Upon arrival at hibernating caves from August through September, Indiana bats "swarm," a behavior in which "large numbers of bats fly in and out of cave entrances from dusk to dawn, while relatively few roost in the caves during the day" (Cope and Humphrey 1977). Swarming continues for several weeks, and mating occurs during the latter part of the period (see "Fall Roost and 'Swarming'"). A majority of bats of both sexes hibernate by the end of November.

Figure 1. Indiana Bat Annual Chronology (from Service 1999f).



Adult females store sperm through the winter and become pregnant via delayed fertilization soon after emergence from hibernation. Young female bats can mate in their first autumn and have offspring the

following year, whereas males may not mature until the second year. Limited mating activity occurs throughout the winter and in late April as the bats leave hibernation (Hall 1962).

Females emerge from hibernation ahead of males; most wintering populations leave by early May. Females may arrive in their summer habitats as early as April 15 in Illinois (Gardner *et al*. 1991a, Brack 1979). Humphrey *et al*. (1977) determined that Indiana bats first arrived at their maternity roost in early May in Indiana, with substantial numbers arriving in mid-May. Birth occurs in late June and early July (Easterla and Watkins 1969, Humphrey *et al*. 1977), and the young are able to fly between mid-July and early August (Mumford and Cope 1958, Cope *et al*. 1974, Humphrey *et al*. 1977, Clark *et al*. 1987, Gardner *et al*. 1991a, Kurta *et al*. 1996).

Survivorship

Humphrey and Cope (1977) determined that female survivorship in an Indiana population of Indiana bats was 76% for ages 1 to 6 years, and 66% for ages 6 to 10 years; for males, survivorship was 70% for ages 1 to 6 years, and 36% for ages 6 to 10 years. The maximum age for banded individuals was 15 years for females and 14 years for males. Mortality between birth and weaning has been estimated at 8% (Humphrey *et al.* 1977). By extending the expected survivorship rates beyond 10 years (Humphrey and Cope 1977) so that the same rate of survivorship found between ages 6 and 10 is extended to their estimated maximum ages (see l_x in Appendix B), the survivorship between birth and 1 year can be estimated at about 50% by using a standard life table and assuming a stable population (Appendix B). Current research has yet to determine when (or why), in the Indiana bat's life, that survivorship has decreased and resulted in the current rate of decline.

Food Habits

Indiana bats feed strictly on flying insects, with prey items reflecting the environment in which they forage (most often terrestrial insects). Indiana bats typically feed in the subcanopy of forests with 60%-80% canopy cover (Garner and Gardner 1992, Romme *et al.* 1995), especially in riparian woodlands (Brack 1983, Gardner *et al.* 1991b, Humphrey *et al.* 1977, LaVal *et al.* 1977), though they also feed in upland areas. Diet varies seasonally and differs with age, sex, and reproductive status (Belwood 1979, Lee 1993). Reproductively active females and juveniles exhibit the greatest dietary diversity, likely because of increased energy needs. Reproductively active females consume more aquatic insects than males or juveniles (Lee 1993).

Moths (Lepidoptera) are major prey items (Belwood 1979; Brack and LaVal 1985; Lee 1993), but caddisflies (Trichoptera) and flies (Diptera) are also documented as major food items (Kurta and Whitaker 1998). Mosquitos and midges are also major food items, especially those species that form large mating aggregations over water (Belwood 1979). Male Indiana bats summering near hibernacula feed primarily on moths and beetles (Service 1999f). Other food items include bees, wasps, and flying ants (Hymenoptera), beetles (Coleoptera), stone flies (Plecoptera), leafhoppers and treehoppers (Homoptera), lacewings (Neuroptera), and true bugs (Hemiptera) (Whitaker 1972, Belwood 1979).

Indiana bats require open water for drinking. Streams, small ponds, wetlands, and even road ruts serve as important sources of drinking water during summer months. Upland water sources appear to be important for all bat species, including Indiana bats. In Indiana, where a habitat model was developed, the highest values were achieved when permanent water sources were available within 66 ft. of roosting sites. Habitat suitability values decline slightly, but are constantly high, from 66 ft. to 0.6 mi. from roost sites. The maximum travel distance reported for Indiana bats is about 2.5 mi. Roosting sites more than 2.5 mi. from water were assumed to be unsuitable (Romme *et al.* 1995). Studies in the Cumberland Plateau and Cumberland Mountains of eastern Kentucky (MacGregor *et al.* 1996) show that ponds and water-filled road ruts in forest uplands are primary water sources for Indiana bats, while stream corridors received relatively little use.

Hibernation

Indiana bats hibernate in winter and are restricted to a few suitable hibernacula (typically caves, but also abandoned mines and even a tunnel and a hydroelectric dam) that are primarily found in the karst region of the Eastern United States. Generally, Indiana bats hibernate from October through April (Hall 1962, LaVal and LaVal 1980), depending on local weather conditions. They hibernate in large, dense clusters, ranging from 300-484 bats per sq. ft. Indiana bats have very specific habitat requirements for a hibernation site to be suitable, with temperature being the most notable. In the southern part of their range, hibernacula trap large volumes of cold air, and the bats hibernate where resulting rock temperatures drop; in the northern part of the range, the bats avoid the coldest sites. In both cases, the bats are choosing cold sites with a low risk of freezing. Stable low temperatures allow the bats to maintain a low metabolic rate that will conserve energy reserves through the winter until spring emergence (Humphrey 1978, Richter *et al.* 1993). Ideal sites are 50°F (10°C) or below when the bats arrive in October and November. Early studies identified a preferred mid-winter temperature range of 39-46°F (4-8°C), but a recent examination of long-term data suggests that a slightly lower and narrower range of 37-43°F (3-6°C) may be ideal for the species (Service 1999f). Further, relative humidity at hibernacula is usually above 74% but below saturation (Hall 1962, Humphrey 1978, LaVal *et al.* 1976, Kurta and Teramino 1994), although relative humidity as low as 54% has been observed (Myers 1964). Humidity may be an important factor in successful hibernation (Thomas and Cloutier 1992). Specific cave configurations determine temperature and humidity microclimates and thus determine the suitability of a cave for Indiana bats, but only a small percentage of available caves provide these conditions.

Indiana bats often hibernate in the same hibernacula with other species of bats and are occasionally observed clustered with or adjacent to other species, including gray bats (*Myotis grisescens*), Virginia big-eared bats (*Plecotus townsendii virginianus*), little brown bats, and northern long-eared bats (Myers 1964, LaVal and LaVal 1980, Kurta and Teramino 1994).

The Indiana Bat Recovery Plan (Service 1999f) ranks hibernation sites into three tiers. More than 85% of the rangewide population occupies nine Priority I hibernacula (hibernation sites with a recorded population >30,000 bats since 1960), three each in Indiana, Kentucky, and Missouri. Priority II hibernacula (between 500 and 29,999 individuals) are found in the previously mentioned three States

and in Arkansas, Illinois, New York, Ohio, Tennessee, Virginia, and West Virginia. Priority III hibernacula (1 to 499 individuals) have been reported from 17 States, including all of the aforementioned, as well as Alabama, Connecticut, Florida, Georgia, Iowa, Maryland, Massachusetts, Michigan, Mississippi, New Jersey, North Carolina, Oklahoma, Pennsylvania, South Carolina, Vermont, and Wisconsin (Service 1999f).

Although hibernating populations are reported to be stable or increasing in some portions of its range (e.g., in Indiana, Illinois, New York, Pennsylvania, and West Virginia), Indiana bat numbers have continued to decline rangewide. The most precipitous declines have occurred in Kentucky and Missouri (Service 1999f).

Fall Roosts and "Swarming"

Before hibernation, Indiana bats undergo "swarming," an activity in which the bats congregate around the hibernacula or other nonhibernation caves, flying into and out of the cave, but typically roosting outside the cave during the day (Cope and Humphrey 1977). Swarming continues for several weeks, during which time the bats replenish fat reserves before hibernation (Service 1983) and mate. Adult female Indiana bats store sperm through the winter and become pregnant, via delayed fertilization, soon after leaving the hibernacula. Indiana bats tend to hibernate in the same cave in which they swarm (LaVal *et al*. 1976), although swarming has occurred in caves other than those in which the bats hibernate (Cope and Humphrey 1977; John MacGregor, USFS, personal observation, 1996). Depending on local weather conditions, swarming may continue through October, or even longer. Males generally remain active longer than the females during this prehibernation period (LaVal and LaVal 1980), probably to maximize their mating possibilities and replenish fat reserves used in pursuit of females. After mating, females enter directly into hibernation. Most individuals (both sexes) are hibernating by the end of November (by mid-October in northern areas [Kurta *in litt*.]), but hibernacula populations may increase throughout the fall and even into January (Clawson *et al*. 1980).

During the fall "swarm," male Indiana bats roost in trees during the day. In Kentucky, male bats have been found roosting primarily in dead trees on upper slopes and ridgetops within 1.5 mi. of their hibernaculum. During September in West Virginia, males have been found roosting in trees near ridgetops within 3.5 mi. of their hibernacula, often switching roost trees from day to day (Craig Stihler, West Virginia Division of Natural Resources, personal observation, 1996). Fall roost sites tend to be more exposed to sunlight than roost sites used at other times of the year (MacGregor, personal observation, 1996).

Spring Roosts

Females emerge from the hibernacula ahead of males, generally in late March or early April, and most wintering populations have dispersed by early May, migrating varying distances to their summer habitats. Spring roosting is, in some respects, not a valid habitat descriptor; because, in part, postemergence movement is mostly directional (i.e., the bats are moving toward their summer habitat), brief, and essentially occurs in summer habitat except, during the time it takes to fly from the hibernacula to their

summer habitat. Females dispersing from a Kentucky hibernaculum in the spring moved 4-10 mi. within 10 days of emergence (MacGregor, *in litt*., 1999). Therefore, spring roosting requirements are likely similar to summer roosting habitat requirements. However, because the bats use some areas only briefly as they move towards their summer habitat, these requirements may be less specific. During this early spring period, females may use several roosts (i.e., small cavities) temporarily, until a roost with larger numbers of bats is established (see maternity roosts). Some males spend the summer near their hibernacula (LaVal and LaVal 1980) while others migrate out of the area. Movements of 2.5-10 mi. have been reported in Kentucky, Missouri, and Virginia (MacGregor, *in litt*., 1999; Hobson and Holland 1995; 3D/International 1996). Males roost in both trees and caves during the summer; presumably, spring habitat requirements are similar to those of summer.

Migration Patterns

Sparse band recovery records, all from the Midwest, indicate that females and some males migrate north in the spring upon emergence from their hibernacula (Hall 1962, Barbour and Davis 1969, Kurta 1980, LaVal and LaVal 1980), though there is evidence of movement in other directions. However, though it appears likely that the majority of individuals migrate north, because of the limited amount of data available on migration and the recent discoveries of reproductive activity further south than previously suspected, interpretation of current data should be cautious.

Summer Habitats

Researchers are still learning about the summer needs of this endangered species, and the perception of what constitutes good habitat and the quantities and the extent of this habitat has evolved over the past few years. Early researchers considered flood-plain and riparian forests to be the primary roosting and foraging habitats used in the summer by the Indiana bat (Humphrey *et al*. 1977), and these forest types are unquestionably important. More recently, upland forests have been shown to be used by Indiana bats for roosting (Clark *et al*. 1987, Gardner *et al*. 1991b, Callahan *et al*. 1997, MacGregor, *in litt*., 1999), and upland forests, old fields, and pastures with scattered trees have been shown to provide foraging habitat (Gardner *et al*. 1991b; MacGregor, *in litt*., 1999).

Throughout the species' range, the presence of the Indiana bat in a particular area may be governed by the availability of natural roost structures, primarily standing dead trees with loose bark. The suitability of any tree as a roost site is determined by (1) its condition (dead or alive); (2) the quantity of loose bark; (3) its solar exposure and location in relation to other trees; and (4) its spatial relationship to water sources and foraging areas.

A number of tree species have been reported to be used as roosts by Indiana bats. These include: American beech (*Fagus grandifolia*), ashes (*Fraxinus* spp.), black gum (*Nyssa sylvatica*), black locust (*Robinia pseudo-acacia*), cottonwood (*Populus deltoides*), elms (*Ulmus* spp.), hickories (*Carya* spp.), maples (*Acer* spp.), oaks (*Quercus* spp.), pines (*Pinus* spp.), sassafras (*Sassafras albidum*), sourwood (*Oxydendrum arboreum*), sweet birch, and yellow buckeye (*Aesculus octandra*) (Cope *et al*. 1974, Humphrey *et al*. 1977, Gardner *et al*. 1991a and b, Garner and

Gardner 1992, Kurta *et al*. 1993, Romme *et al*. 1995, Kiser and Elliott 1996, Kiser *et al*. 1996, Kurta *et al*. 1996, Callahan *et al*. 1997). Morphological characteristics of the bark of several trees make them suitable as roosts for Indiana bats; that is, when dead, senescent, or severely injured (e.g., lightning), trees possess bark that springs away from the trunk upon drying. Additionally, the shaggy bark of some living hickories (*Carya* spp.) and large white oaks also provide roost sites. The persistence of peeling bark varies with the tree species and the severity of environmental factors to which it is subjected. While some tree species are undoubtedly more often suitable as roosting habitat, structure (exfoliating bark with space for bats to roost between the bark and the bole of the tree) is more important than the species of the tree.

Indiana bat maternity colonies have multiple roosts, in both dead and living trees. "Primary" roosts are generally in openings or at the edge of forest stands, while "alternate" roosts (based upon the proportion of bats in a colony occupying the roost site) can be in either the open or the interior of forest stands. Maternity colonies have at least one primary roost (up to three have been identified for a single colony) used by most of the bats throughout the summer. Colonies may also have multiple alternate roosts used by small numbers of bats intermittently throughout the summer (Service 1999f). Kurta *et al.* (1996) studied a maternity colony in northern Michigan over a 3-year period and noted that bats changed roost trees an average of every 2.9 days and that the number of roosts used by the colony ranged from 5 to 18. Other studies have shown that adults in maternity colonies may use as few as 2, or as many as 33, alternate roosts (Humphrey *et al*. 1977, Gardner *et al.* 1991a, Garner and Gardner 1992, Callahan 1993, Kurta *et al.* 1993, Romme *et al.* 1995).

Indiana bats move from one roost to another within a season, as well as in response to changes in environmental conditions (temperature and precipitation) or when a particular roost becomes unavailable (Gardner *et al*. 1991a, Callahan *et al*. 1997). Therefore, the importance of an individual roost site may not be as important as some researchers have suggested (Humphrey *et al.* 1977), and the Indiana bat may be more adaptable concerning roosting habitats than previously believed. However, though the species appears to be an adaptable animal that takes advantage of the ephemeral habitat available to it, it is apparent that a variety of suitable roosts within a colony's occupied summer range should be available to assure the continuance of the colony in that area (Kurta *et al*. 1993, Callahan *et al*. 1997).

Most roost trees used by a maternity colony are close to one another, and the spatial extent and configuration of a colony's regular use area is probably determined by the availability of suitable roosts. The distances between roosts occupied by bats within a single maternity colony have ranged from just a few yards to several miles and, in one case, 3.1 mi. (Callahan 1993, Callahan *et al*. 1997, Service 1999f).

Thermoregulation may be a factor in roost site selection. Therefore, exposure to sunlight and location relative to other trees are likely important factors in suitability and use. Because cool temperatures can delay the development of fetal and juvenile young (Racey 1982), selection of maternity roost sites may be critical to reproductive success. Primary roosts are generally not surrounded by a closed canopy and can be warmed by solar radiation, thus providing a favorable microclimate for the growth and

development of young during normal weather. Additionally, dead trees with east-southeast and south-southwest exposures may allow solar radiation to warm nursery roosts effectively. Roosts in some species of living trees (e.g., shagbark hickory [*Carya ovata*]), on the other hand, may provide better protection from rain and other unfavorable environmental conditions because the greater thermal mass of these live trees can maintain more favorable temperatures for roosting bats during cool periods (Humphrey *et al*. 1977). The tight bark of these trees shields bats from the encroachment of water into the roost during rain events (Callahan *et al*. 1997). Snags exposed to direct solar radiation were used most frequently by Indiana bats as summer roosts, followed by snags not fully exposed to solar radiation and live trees not fully exposed (Callahan 1993).

Alternate roosts tend to be more shaded, are frequently within forest stands, and are selected when temperatures are above normal or during periods of precipitation. Shagbark hickories again seem to provide particularly good alternate roosts because of the factors listed above. Roost site selection and use may differ between the northern and southern parts of the species' range, but, to date, such analyses have not been undertaken.

Known primary roost trees have ranged in size from 12.2-29.9 in. dbh (summarized in Romme *et al*. 1995). Miller (1996) compared Indiana bat habitat variables for sites in northern Missouri and noted that significantly larger trees (>12 in. dbh) were found where reproductively active Indiana bats had been netted than at sites at which bats had not been captured. Alternate roost trees also tend to be large, mature trees, but the range in size is somewhat wider than that of primary roosts (7.1-32.7 in. dbh) (Romme *et al.* 1995).

Because some characteristics of roosting habitat preferred by Indiana bats are ephemeral, it is difficult to generalize or estimate their longevity due to the many factors that influence them (bark may slough off completely or the tree may fall over). Although roosts may only be habitable for 1 to 2 years under "natural conditions" for some tree species (Humphrey *et al*. 1977), others with good bark retention, such as slippery elm (*Ulmus fulva*), cottonwood, green ash (*Fraxinus pennsylvanica*), and oaks, may provide roosting habitat 4 to 8 years (Gardner *et al*. 1991a, Callahan *et al*. 1997, Service 1999f). Hickories also retain bark well.

Indiana bats exhibit varying degrees of site fidelity to summer colony areas, roosts, and foraging habitat. Females have been documented returning to the same roosts from 1 year to the next (Bowles 1981, Humphrey *et al*. 1977, Gardner *et al*. 1991a and b, Callahan *et al*. 1997). Kurta *et al*. (1996), however, noted that individuals in a maternity colony in northern Michigan "were not highly faithful to a particular tree." In Illinois, male Indiana bats exhibited some site fidelity to summering areas they had occupied during previous years (Gardner *et al*. 1991b).

Most maternity records for the Indiana bat originated in the Midwest (southern Iowa, northern Missouri, northern Illinois, northern Indiana, southern Michigan, and western Ohio). The first maternity colony was found, and several studies of Indiana bat maternity habitat were conducted, in this Midwest region. Although the woodlands in this glaciated region are mostly fragmented, it has a relatively high density of maternity colonies. Today, small bottomland and upland forested tracts with predominantly

oak-hickory forest types and riparian/bottomland forests of elm-ash-cottonwood associations exist in an otherwise agriculturally dominated (nonforested) landscape (Service 1999f). Unglaciated portions of the Midwest (southern Missouri, southern Illinois, southern Indiana), Kentucky, and most of the eastern and southern portions of the species' range appear to have fewer maternity colonies per unit area of forest. However, this may be an artifact in comparing these areas with the highly fragmented Midwestern forests.

Indiana bats occupy distinct home ranges during the summer (Gardner *et al.* 1990). Average home range sizes vary from about 70 ac. (juvenile males) to more than 525 ac. (postlactating adult females). Roosts occupied by individuals range from 0.33 mi. to more than 1.6 mi. from preferred foraging habitat but are generally within 1.2 mi. of water (e.g., stream, lake, pond, natural or manmade water-filled depression).

Foraging habitat and behavior

Indiana bats forage in and around the tree canopy of flood-plain, riparian, and upland forests. In riparian areas, Indiana bats primarily forage around and near riparian and flood-plain trees; e.g., sycamore (*Platanus occidentalis*), cottonwood, black walnut (*Juglans nigra*), black willow (*Salix nigra*), and oaks, as well as solitary trees and forest edge on the flood plain (Belwood 1979, Cope *et al*. 1974, Humphrey *et al*. 1977, Clark *et al*. 1987, Gardner *et al*. 1991b). Within flood-plain forests where Indiana bats forage, canopy closures range from 30%-100% (Gardner *et al*. 1991b). Cope *et al*. (1978) characterized woody vegetation within a width of at least 30 yards on both sides of a stream as excellent foraging habitat. Streams, associated flood-plain forests, and impounded bodies of water (e.g., wetlands, reservoirs) are preferred foraging habitats for pregnant and lactating Indiana bats, some of which may fly up to 1.5 mi. from upland roosts (Gardner *et al*. 1991b). Indiana bats also forage within the canopy of upland forests, over clearings with early successional vegetation, along the borders of croplands, along wooded fencerows, and over farm ponds in pastures (Clark *et al*. 1987, Gardner *et al*. 1991b).

Indiana bat maternity colony foraging areas have ranged from a linear strip of creek vegetation 0.5 mi. in length (Belwood 1979, Cope *et al*. 1974, Humphrey *et al*. 1977) to a foraging area 0.75 mi. in length, within which bats flew over a wooded river or around the riverside trees (Cope *et al*. 1978). Indiana bats return nightly to their foraging areas (Gardner *et al*. 1991b).

Indiana bats usually forage and fly within an air space from 6-100 ft. above ground level (Humphrey *et al*. 1977). Most Indiana bats caught in mist nets are captured over streams and other flyways at heights greater than 6 ft. (Gardner *et al*. 1989).

During summer, male Indiana bats that remained near their Missouri hibernacula flew cross-country or upstream toward narrower, more densely wooded riparian areas during nightly foraging bouts, perhaps due to interspecific competition with gray bats. Some male bats also foraged at the edges of small flood-plain pastures, within dense forests, and on hillsides and ridgetops; maximum reported distance was 1.2 mi. (LaVal *et al*. 1976, LaVal *et al*. 1977, LaVal and LaVal 1980). In Kentucky, MacGregor (*in litt*., December 1998) reported that the maximum distance males moved from their hibernaculum in the summer was about 2.6 mi. In the fall, male Indiana bats tend to roost and forage in upland and ridgetop forests, but may also forage in valley and riparian forests; movements of 1.8-4.2 mi. have been reported in Kentucky and Missouri (Kiser and Elliott 1996, 3D/International 1996, MacGregor, *in litt*., June 1997).

Summer Habitat Model

Romme *et al.* (1995) developed a habitat suitability index (HSI) model for the Indiana bat that identified nine variables believed to be the major components of summer habitat for the species. The model was developed for use in southern Indiana, but it may also be applicable in other areas within the species' range. The five variables considered important for roosting habitat within the analysis areas included: (1) the amount of overstory canopy, (2) the diameter of overstory trees, (3) the density of potential live roost trees, (4) snag density, and (5) the amount of understory cover. Variables considered important foraging habitat components included the amount of overstory canopy and the percentage of trees between 2 in. and 4.7 in. dbh. Distance to water and percentage of the analysis area with forest cover are also considered to be important habitat variables. The habitat model also classifies species of trees that may provide roosts for Indiana bats (Class I through Class III, with Class I being the most important). Class I trees include:

Silver maple
Shagbark hickory
Shellbark hickory
Bitternut hickory Green ash White ash
Eastern cottonwood
Red oak Post oak
White oak Slippery elm
American elm

These species are likely to develop the loose, exfoliating bark as they age and/or die that is preferred by Indiana bats as roosting sites. Class II trees were identified (including sugar maple, shingle oak [*Quercus imbricaria*], and sassafras) as species believed to be of somewhat lesser value for roosting Indiana bats. Class III trees are all other species of trees not included in the other two classes. Class II and III trees are species that are less likely to provide optimal roosting habitat but may develop suitable cracks, crevices, or loose bark after the trees die.

In southern Indiana, where the HSI model was developed, optimal Indiana bat roosting habitat consists of areas that are within 0.6 mi. of open water and contain at least 30% forest cover that meets the following requirements: (a) roosting habitat consisting of overstory canopy of 60%-80%, overstory trees with an average dbh of 15.7 in. at a density of at least 16 or more per acre, snags with a dbh of at least 8.7 in. at a density of at least six snags per acre, understory cover (i.e., from 2 meters above the forest floor to the bottom of the overstory canopy) of 35% or less and (b) foraging habitat consisting of overstory canopy cover of 50% to 70%, with 35% or less of the understory trees between 2 in. and 5 in. dbh (Romme *et al.* 1995).

Threats to the Species

Not all of the causes of the Indiana bat population decline have been determined. Although several known human-related factors have caused population declines in the past, they may not be entirely responsible for recent declines. Several known and suspected causes of decline are discussed below.

Disturbance and vandalism. A serious cause of Indiana bat decline has been human disturbance of hibernating bats during the decades of the 1960s through the 1980s. Bats enter hibernation with only enough fat reserves to last until spring. When a bat is aroused, as much as 68 days of fat supply is used in a single disturbance (Thomas *et al.* 1990). Humans (including recreational cavers and researchers) passing near hibernating Indiana bats can cause arousal (Humphrey 1978, Thomas 1995, Johnson *et al.* 1998). If this happens too often, a bat's fat reserves may be exhausted before the species is able to forage in the spring.

Direct mortality due to human vandalism has been documented. The worst known case occurred in 1960 when an estimated 10,000 Indiana bats were killed in Carter Caves State Park, Kentucky, when three youths tore masses of bats from the ceiling and trampled and stoned them to death (Mohr 1972). Another documented incident was reported from Thornhill Cave in Kentucky, where at least 255 Indiana bats were killed by shotgun blasts in January 1987 (Anonymous 1987).

Improper cave gates and structures. Some hibernacula have been rendered unavailable to Indiana bats by the erection of solid gates in the entrances (Humphrey 1978). Since the 1950s, the exclusion of Indiana bats from caves and changes in air flow are the major causes of loss in Kentucky (an estimated 200,000 bats at three caves)[3] (Service 1999f). Other cave gates have so modified the climate of hibernacula that Indiana bats are unable to survive the winter because changes in air flow elevated temperatures, which caused an increased metabolic rate and a premature exhaustion of fat reserves (Richter *et al.* 1993; Merlin Tuttle, Bat Conservation International, *in litt*., 1998).

Conversely, an Indiana bat population may be restored if an improper gate is replaced with one of appropriate design or if air flow is restored. In Wyandotte Cave in Indiana, dramatic population increases followed gate replacement and the restoration of traditional air flow (Richter *et al*. 1993). Improved air flow facilitated by the enlargement of an upper level entrance was apparently responsible for a three-fold increase in Indiana bat numbers in Ray's Cave in Indiana (Brack *et al*. 1991). The recovery of hibernating populations to historic levels, however, have not been as successful elsewhere. At Hundred Dome Cave in Kentucky, predicted population gains have never been realized, although air flow obstructions have been removed and gates suitable for the species have been installed (Service 1999f).

Natural hazards. Indiana bats are subject to a number of natural hazards. River flooding in Bat Cave at Mammoth Cave National Park in Kentucky caused large numbers of Indiana bats to drown (Hall 1962). Other cases of hibernacula being flooded have been recorded by Hall (1962), DeBlase *et al*. (1965), and the Service (1999).

[3] Most of the obstructions have since been removed or redesigned.

Bats hibernating in mines are vulnerable to ceiling collapse (Hall 1962), and this is a concern at Pilot Knob Mine in Missouri, once the largest known Indiana bat hibernating population. To a lesser extent, ceiling collapse in caves is also possible.

Another hazard exists because Indiana bats hibernate in cool portions of caves that tend to be near entrances, or where cold air is trapped. Some bats may freeze to death during severe winters (Humphrey 1978, Richter *et al.* 1993). Indiana bats apparently froze to death in Bat Cave (Shannon County, Missouri) in the 1950s (Service 1999f). The population at this site was 30,450 in 1985, when the bats were observed roosting on a high ceiling, presumably to escape severe cold at their traditional roosting ledges 7-9 ft. above the cave floor. In a subsequent 1987 survey, the population had plummeted to 4,150 bats, and the cave floor was littered with bat bones, suggesting that the bats died during hibernation, apparently freezing to death (Service 1999f).

At Missouri's Great Scott Cave, average mid-winter temperatures appear to have risen 8°F (4.4°C) from the mid-1980s through the present, compared with temperatures in the 1970s and early 1980s. A major population loss occurred between the mid-1980s and 1998. A detailed analysis is needed, along with detailed temperature profiles of this and other hibernacula, to better understand the relationship(s) between climate, air flow, and hibernation microclimates within important hibernacula.

Indiana bats are vulnerable to the effects of severe weather when roosting under exfoliating bark during summer. For example, a maternity colony was displaced when strong winds and hail produced by a thunderstorm stripped the bark from their cottonwood roost and the bats were forced to move to another roost (Service 1999f).

Other. Other documented sources of decline include indiscriminate collecting, handling and banding of hibernating bats by biologists, and flooding of caves due to rising waters in reservoirs (Humphrey 1978).

Microclimate effects. Changes in the microclimates of caves and mines may have contributed more to the decline in population levels of the Indiana bat than previously estimated (Tuttle, *in litt*. August 4, 1998). Entrances and internal passages essential to air flow may become larger, smaller, or closed, with concomitant increases or decreases in air flow. The blockage of entry points, even those too small to be recognized, can be extremely important in hibernacula that require chimney-effect air flow in order to function.

Hibernacula in the southern portions of the Indiana bat's range may either be near the warm edge of the bat's hibernating tolerance or have relatively less stable temperatures. Hibernacula in the northern portion of its range may have passages that become too cold, and the bats must be able to escape particularly cold temperatures. In the former case, bats may be forced to roost near entrances or floors to find low enough temperatures, thus increasing their vulnerability to freezing or predation. In both cases, modifications that obstruct air flow or bat movement could adversely affect the species (Service 1999f).

Recent analysis of mid-winter temperature records obtained during hibernacula surveys, especially of Priority I caves, suggests that unacceptable deviations in roost temperatures may account for some of the overall population decline (M. Tuttle, *in litt*., August 4, 1998). Although scanty, the data suggest that when populations roost mostly at temperatures below 35°F or above 47°F (2°C and 8°C), they usually decline, and when roosting between 37°F and 45°F (3°C and 7.2°C) they tend to grow.

To test the hypothesis that changes in the microclimates of Indiana bat hibernation sites may be contributing to the recent downward trend in this species, the temperature and relative humidity of 13 major hibernacula in Indiana, Kentucky, Missouri, Tennessee, and Virginia were monitored. Investigations revealed that crucial air flow had been interrupted at some sites, and the air temperature had risen a few degrees above optimal levels in others, providing additional initial evidence that changes in microclimates may be contributing to this species' drastic decline (Tuttle, *in litt*., August 4, 1998). Additional years of monitoring at these sites will be necessary to further evaluate any changes in hibernation conditions.

Land-use practices. Habitat within the Indiana bat's maternity range has changed dramatically since presettlement times (Schroeder 1981, Giessman *et al*. 1986, MacCleery 1992, Nigh *et al.* 1992). Most of the forest in the upper Midwest has been fragmented, fire has been suppressed, and native prairies have been converted to agricultural crops or to pasture and hay meadows for livestock. Native species have been replaced with exotics in large portions of the maternity range, and plant communities have become less diverse than occurred prior to settlement. Additionally, many chemicals are applied to these intensely agricultural areas. The changes in the landscape and the use of chemicals (McFarland 1998) may have reduced the availability and abundance of the bat's insect forage base.

Conversely, regions surrounding hibernacula in the Missouri Ozarks and elsewhere are now more densely forested than they were historically (Sauer 1920, Ladd 1991, Jacobson and Primm 1997). Consequently, the open, savannalike conditions that may have been important to the species maternity habitat (Romme *et al.* 1995) in part of its range are much less abundant today than occurred historically (Service 1999f).
In the Eastern United States, the area of land covered by forest has been increasing in recent years (MacCleery 1992) but is still young by historical standards. Whether this is beneficial to the Indiana bat is unknown. The age, composition, and size-class distribution of the woodlands will have a bearing on their suitability as roosting and foraging habitat for the species outside the winter hibernation season. An understanding of the factor or factors responsible for the continued decline of the species is needed before it can accurately be determined whether the loss of roosting habitat is limited to regional or rangewide populations (Service 1999f).

Chemical contamination. Pesticides have been implicated in the declines of a number of insectivorous bats in North America (Mohr 1972; Reidinger 1972, 1976; Clark and Prouty 1976; Clark *et al*. 1978; Geluso *et al*. 1976; Clark 1981). The effects of pesticides on Indiana bats have yet to be studied. McFarland (1998) studied two sympatric species--the little brown bat and the northern long-eared bat--as surrogates in northern Missouri and documented depressed levels of acetylcholinesterase, suggesting that bats there may be exposed to sublethal levels of carbamate and/or organophosphate

insecticides applied to agricultural crops. McFarland (1998) also showed that bats in northern Missouri are exposed to significant amounts of agricultural chemicals, especially those applied to corn. BHE Environmental, Inc. (1999), collected tissue and guano samples from five species of bats at Fort Leonard Wood, Missouri, and documented the exposure of bats to p,p'-DDE, heptachlor epoxide, and dieldrin.

Status of the Species in North Carolina

Several documented and unverified Indiana bat records exist for the last 60 years in North Carolina. The Agency Draft Indiana Bat Recovery Plan (Service 1999f) lists county records for Henderson, Jackson, Rutherford, Mitchell, and Swain Counties. The Henderson County record is in error because the cave where the Indiana bat has been found is in Rutherford County and the location has been tallied for both counties.

Boynton *et al.* (1992) summarized information for the known Indiana bat records in North Carolina. The Mitchell County record is based on one specimen, date unknown. There is one specimen from Swain County (Hewitt Station, an abandoned mine) collected before 1962. The North Carolina State Museum of Natural Sciences has four specimens of Indiana bats collected in 1947 from Rutherford County at what is now the Bat Cave Preserve (owned and managed by The Nature Conservancy). This complex system of fissure caves was surveyed in 1984, 1991, 1995, and 1997. Individual Indiana bats were found in 1984 and 1991.

On July 25, 1999, a postlactating female and a juvenile male Indiana bat were captured on upper Santeetlah Creek in the Nantahala National Forest, Graham County, North Carolina. A radio transmitter was attached to the female, and she was tracked to a large dead Canadian hemlock the following night. A juvenile female Indiana bat was captured the same night. Monitoring over the next several nights documented 28 bats using the same hemlock as a roost site. This represents the first likely maternity colony found in North Carolina and the first summer breeding found south of Kentucky. White Oak Blowhole Cave in Blount County, Tennessee, is slightly more than 5 mi. northeast of Graham County, North Carolina. This cave is a Priority II hibernacula and has been designated as critical habitat for the Indiana bat. The winter population at this hibernaculum has undergone an inconsistent decline (Figure 2) since a high of 11,287 Indiana bats were counted in 1981. Only 3,084 were found in 1999.

ENVIRONMENTAL BASELINE

Under section 7(a)(2) of the Act, when considering the "effects of the action" on federally listed species, we are required to take into consideration the environmental baseline. The environmental baseline includes past and ongoing natural factors and the past and present impacts of all Federal, State, or private actions and other activities in the action area (50 CFR 402.02), including Federal actions in the area that have already undergone section 7 consultation, and the impacts of State or private actions that are contemporaneous with the consultation in process. The environmental baseline for this Opinion considers all USFS projects approved prior to the initiation of formal consultation with the Service (October 18, 1999).

The action area for this consultation, though it covers over one million acres, impacts less than 1% of the known range of the Indiana bat. Similarly, it is likely that less than 2% of the known Indiana bat population occurs within the consultation area (see "Proximity to Hibernacula"). No critical habitat occurs within the project area.

At this time no Indiana bat hibernacula are known to occur on the NPNFs. The hibernaculum closest to the NPNFs is Whiteoak Blowhole cave in the Great Smoky Mountains National Park in Tennessee (see "Status of the Species in North Carolina"). The Indiana bat population at this Priority II hibernacula has ranged from about 3,000 bats to more than 11,000 (Figure 2). This hibernaculum is the likely origin of any Indiana bats that might establish maternity roost sites on the NPNFs. There is no USFS land within 10 mi. of this cave; however, within 20 mi. of the cave there are over 17,000 ac. of suitable Indiana bat habitat (see "USFS Assessment of Current Habitat Conditions for the Indiana Bat on the Nantahala and Pisgah National Forests") on the NPNFs. Within 40 mi. there are 131,000 ac., and within 100 mi. there are 408,000 ac. (Table 5).

Table 5. Suitable Indiana Bat Habitat on the Nantahala and Pisgah National Forests near Whiteoak Blowhole Cave Hibernacula.

Radius from Hibernacula	Total acres	USFS - acres	Suitable Indiana Bat Habitat on Nantahala and Pisgah National Forests
20 miles (mi.)	800,128	50,040	17,140
40 mi.	3,200,526	329,740	131,030
60 mi.	7,201,238	635,260	262,845
100 mi.	20,003,584	888,120	408,520
130 mi.	33,806,119	1,027,380	490,000

Following the discovery of the Indiana bat in Graham County, North Carolina, the Service advised the USFS that, based on habitat similarities, the species may be present in adjacent counties (Macon, Swain, and Cherokee). The USFS evaluated their responsibilities under the Act and suspended activities involving the cutting of trees in those counties until the effects of ongoing and proposed actions could be determined. The Service consulted with the USFS on several projects (see "Consultation History") and agreed that these projects were not likely to adversely affect the Indiana bat. Other ongoing and proposed projects were determined by the USFS to have "no effect." All consultations with the USFS concerning the Indiana bat on USFS land in western North Carolina since the Graham County discovery have been on the Nantahala National Forest in Graham, Cherokee, Macon, and

Swain Counties, North Carolina. Projects outside this four-county area on the Nantahala National Forest and all of the Pisgah National Forest have continued following informal consultation on the Indiana bat.

USFS Assessment of Current Habitat Conditions for the Indiana Bat on the Nantahala and Pisgah National Forests

In the BA, the USFS described the current quality and quantity of Indiana bat summer habitat[4] on the NPNFs. Five summer habitat variables were selected for analysis of summer habitat conditions: (1) percent canopy cover, (2) number and size of live potential roost trees, (3) tree species/forest type, (4) number and size of dead roost trees (snags), and (5) percent of area forested. Specific habitat suitability criteria for identifying habitat suitability threshold levels were determined after reviewing HSI values developed by Romme *et al.* (1995), other research studies, and threshold criteria levels used by other national forests.

In evaluating the quality and availability of Indiana bat habitat, both at current conditions and those projected at the end of the life of the Forest Plan, the USFS assessed habitat conditions on three scales--(1) at the timber stand level, (2) 2-mi diameter circles (see "Focal Analysis"), and (3) across the forest landscape. In the USFS's analysis, three levels of habitat quality were also established--(1) optimal habitat, (2) suitable habitat, and (3) unsuitable habitat. These levels of habitat quality were established using a combination of sources, including recent scientific field studies, personal communications from recognized professional bat biologists, habitat suitability criteria levels used by other national forests, Forest Inventory and Monitoring (FIM) data, field data collected on the NPNFs, past research studies, communications with the Service, and the Indiana Bat HSI model developed by Romme *et al.* (1995)[5]. Depending on the habitat variable, habitat suitability threshold criteria were established and used to display spatially and tabularly the amount and distribution of suitable habitat. In some instances, the minimum suitable levels were used for the analysis, while for other habitat elements, an optimal habitat criteria was used. The choice between optimal versus suitable criteria depended on the available information.

Evaluation of Roosting Habitat on the Nantahala and Pisgah National Forests

The following four habitat variables were used to define and evaluate Indiana bat summer roosting habitat suitability:

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[4] The USFS defined summer habitat as the habitat used primarily by female Indiana bats to bear their young. Although male Indiana bats may also use these same types of habitats, it is assumed that habitat suitable for females and young will also provide suitable habitat for males that may sporadically occur in the same general habitat. The two primary habitat components of summer habitat are roosting habitat and foraging habitat.

[5] This model was developed for conditions in Indiana and may not be completely applicable to conditions in western North Carolina. However, this model provides the best available information from which to derive a method for evaluating summer habitat conditions.

1. **Percent Canopy Cover**: A wide range of canopy coverage conditions exists at known summer maternity and other summer roosts. Romme *et al*. (1995) used an HSI value of 60%-80% canopy cover as providing optimal summer maternity roosting habitat. No HSI value was predicted to represent less than optimal canopy coverage conditions. However, studies conducted by MacGregor (personal communication, 1999) on the Daniel Boone National Forest in Kentucky, indicate that male Indiana bats have been found using roost trees where canopy cover was as low as the mid-20% range.

   The NPNFs do not currently collect percent canopy cover information when conducting silvicultural examinations; there are no existing models from which to predict relationships between forest type, forest age, site quality, size of trees, tree density, and canopy coverage conditions for Southern Appalachian hardwood forests. Information provided by the forest silviculturist shows an acceptable relationship between forest age and stand condition class (stand density) to predict at least optimal canopy coverage conditions (refer to Appendix C of the BA). Consequently, the USFS used >60% canopy coverage[6] to assess this habitat variable across the NPNFs. No attempt was made to analyze habitat conditions based on the suitable criteria, only optimal criteria.

   Optimal maternity roost habitat overstory conditions are being provided on about 57% of the forested acres on the NPNFs with no appreciable change being predicted over the next 5 years (Table 6).

Table 6. Acres of Optimal (Roosting Habitat) Canopy Closure (>60%).

Forest Grouping	Current Condition	% Current Condition	Projected 2004	% Projected 2004
Cove Hardwood	236,641	43%	236,849	43%
Upland Hardwood	290,380	53%	290,982	53%
Yellow Pine-Hardwood	25,412	4%	25,412	4%
Total Acres	552,433		553,243	

2. **Number and Size of Live Potential Roost Trees (number of trees and diameter):** Romme *et al*. (1995) used an HSI value of at least 16 trees/acre, of at least 9 in. dbh, as providing optimal roosting habitat conditions. The USFS's analysis of FIM data shows that stand age can be used as an indicator of when stands provide the desired number of a certain size tree. Their analysis used at least 16 trees/acre as optimal and 8-15 trees/acre as suitable (refer to Appendix C of the BA).

   The USFS's analysis also evaluated the availability of forest stands to provide 16-in. dbh trees as live roost trees and potential future roost trees. The USFS used three trees per acre or greater as

[6] While this will include some portions of the forest with an upper canopy closure greater than 80% (outside the optimum range), this would be only a slight over estimate because only a small percentage of hardwood stands have canopy closures above 80% (Steve Simon, Plant Ecologist, NPNFs, personal communication, 2000).

providing optimal habitat conditions. Their analysis of FIM data indicates that a stand age of at least 70 years will provide optimal numbers of 16-in. dbh trees.

Optimal tree densities, which are a component of potential live roost tree conditions, are being provided on about 83% of the forested acres on NPNFs (Table 7). An additional 4,000+ ac will reach "optimal" conditions in the next 5 years.

Table 7. Acres Providing at least 16 Trees/Acre and >9 in. dbh (Optimal Roosting Habitat)

Forest Grouping	Current Condition	% Current Condition	Projected 2004	% Projected 2004
Cove Hardwood	329,039	41%	331,224	41%
Upland Hardwood	440,814	55%	442,984	55%
Yellow Pine-Hardwood	34,622	4%	34,667	4%
Total Acres	804,475		808,875	

The mean diameter of primary roost trees is approximately 15.7 in. dbh (Romme *et al.* 1995). An estimated 58% of forested acres of the NPNFs provide habitat with optimal densities of larger diameter roost trees (Table 8). For this analysis, the USFS used an age of 70 years or greater to identify stands that would more than adequately provide at least three trees per acre (Table 9); over 100,000 ac. will become more than 70 years of age by 2004. This analysis predicts that more than 69% of the forested acres on the NPNFs will provide optimal densities of larger-diameter live potential roost trees. Using the list of Class I and II tree species developed by Romme *et al.* (1995), an analysis of forest CISC types on the NPNFs shows that approximately 886,270 ac., or roughly 91% of forested acres on the NPNFs contain Class I and II trees that potentially could provide suitable Indiana bat habitat conditions.

Table 8. Acres Providing at Least Three 16-in. dbh Trees/Acre (Optimal Habitat).

Forest Grouping	Current Condition	% Current Condition	Projected 2004	% Projected 2004
Cove Hardwood	195,815	35%	246,824	37%
Upland Hardwood	343,784	61%	395,372	59%
Yellow Pine-Hardwood	25,675	4%	30,251	4%
Total Acres	565,274		672,447	

Table 9. Age-class Distribution for Forested Acres Consisting of Suitable Forest CISC Types, for Current Year and Projected Year 2004 (No Management).

Age-class	Current	Percent	2004	Percent	Change
0-10	22,548	3%	6056	1%	-16,528
11-20	28,729	3%	37,249	4%	+8,520
21-30	19,286	2%	18,415	2%	-871
31-40	11,196	1%	15,670	2%	+4,474
41-50	15,065	2%	11,205	1%	-3,860
51-60	52,349	6%	23,411	3%	-28,938

61-70	171,787	19%	101,817	11%	-69,970
71-80	213,693	24%	207,305	23%	-6,388
81-90	130,554	15%	179,693	20%	+49,139
91-100	81,019	9%	104,409	12%	+23,390
>100	140,008	16%	181,040	20%	+41,032

3. **Tree Species (Class I and II trees):** Using the Class I and Class II tree species listed by Romme *et al*. (1995), forest CISC types were evaluated and categorized as either representing potentially suitable or unsuitable Indiana bat habitat. Unsuitable CISC types included those types classified as conifers. Potentially suitable CICS types were then grouped into three major forest groupings--Cove Group, Upland Group, and Yellow Pine-Hardwood Group. A specific listing of those CISC types, considered to represent potentially suitable Indiana bat habitat, is provided in the BA.

4. **Number/Size of Dead Roost Trees (Snags) >9 in. dbh:** The USFS used three data sets to estimate the number of snags in stands and to project their extent on the NPNFs (refer to Snag Process Paper, Appendix B of the BA). Romme *et al.* (1995) used an HSI value of six snags per acre >9 in. dbh as providing optimal snag habitat conditions. The USFS's analysis used three to five snags per acre as providing suitable habitat conditions and six or greater snags per acre as providing optimal conditions. The USFS analysis showed that suitable snag conditions would be met at 60 years or greater for cove and upland hardwood forest types but at 40 years or greater for yellow pine-hardwood stands. Their analysis used only suitable habitat conditions to assess Indiana bat habitat conditions across the NPNFs. Data does not exist to conduct an analysis using the optimal habitat criteria.

   Most female Indiana bats have been found on snags >8.7 in. dbh (Romme *et al.* 1995). Using 8.8 in. dbh, the USFS's analysis indicates that suitable snag density conditions are being achieved on at least 76% of the forested acres on the NPNFs (Table 10). An additional 35,000+ ac will become suitable by 2004.

Table 10. Acres Providing At Least Three Snags Per Acre, >8.8 in. dbh (Suitable Habitat)

Forest Grouping	Current Condition	% Current Condition	Projected 2004	% Projected 2004
Cove Hardwood	285,590	39%	308,803	40%
Upland Hardwood	419,035	57%	431,438	56%
Yellow Pine-Hardwood	34,622	4%	34,667	4%
Total Acres	739,247		774,908	

The USFS's assessment of habitat conditions shows that a very high percentage of the forested acres on the NPNFs provide at least suitable summer maternity roost habitat conditions. To analyze and display the spatial availability of stands that concurrently provide optimal habitat conditions relative to the number of 16-in. dbh potential live roost trees, roosting canopy closure, and suitable conditions for snags, a focal analysis was conducted of forest CISC types that have been identified as potentially providing suitable Indiana bat habitat (see "Focal Analysis").

Evaluation of Summer Foraging Habitat on the Nantahala and Pisgah National Forests

Though Romme *et al.* (1995) stated that optimum foraging habitat is found where percent canopy closure falls between 50% and 70%, other studies have shown that Indiana bats will also forage along the edges of timber regeneration areas, agricultural openings, and near clumps of overstory trees left in timber regeneration areas (Garner and Gardner 1992). In fact, the greatest amount of bat activity occurs along edges between intact forest and cut areas, though rarely next to large clearcuts (Barclay and Brigham 1998). The Allegheny National Forest has documented Indiana bats foraging in areas with canopy closures roughly estimated between 0% and 50%, suggesting that Indiana bats use a wide range of habitat conditions as foraging habitat.

Riparian areas have also been documented as representing important foraging habitat for Indiana bats. Using 100-foot buffers on each side of perennial streams and rivers as an approximation of riparian habitat, total riparian habitat on the NPNFs is estimated to be 99,800 ac.

Suitable foraging habitat can be found throughout the NPNFs, especially where suitable habitat thresholds are met for percent canopy closure, numbers of large snags, and number and species of live trees >9 in. dbh. Suitable Indiana bat foraging habitat is not limited in distribution or abundance across the NPNFs.

Analysis of Indiana Bat Habitat Conditions in Stands Following Recent Timber Harvesting

An average of 2,077 ac. have been silviculturally treated annually[7] since 1994 (Table 3). In all categories, the actual reported level of timber treatments fell below levels estimated and analyzed in the Forest Plan. The USFS evaluated Indiana bat habitat conditions in stands harvested within the last 3 to 5 years by evaluating select harvest units.

The Forest Plan projects about 2,500 ac. to be harvested per year under the two-aged shelterwood system. However, since the implementation of the Forest Plan, only about 600 ac. per year have been sold. Projections for the next 5 years indicate that from 600-2,500 ac. per year will be regenerated using two-aged shelterwood harvesting. A review of data for residual trees on two-aged shelterwood harvests reveals that the average harvest unit is about 15-20 ac. The typical leave residual basal area on these hardwood sites is about 20-30 sq. ft., with leave trees ranging from 8-28 in. dbh. On average, about 10-20 trees/acre >9 in. dbh are left as residual trees, and about five of those trees left in regeneration units are >16 in. dbh. At least three snags/acre >9 in. dbh are present after harvesting.

The USFS's analysis of postharvest shelterwood conditions indicates that at the stand level, on average, areas harvested by two-aged shelterwood harvesting, selection harvesting, and thinning currently meet (at least minimally) suitable habitat criteria for the number of trees (16 trees/acre >9 in. dbh), size of

[7] Throughout this Opinion, "annual" refers to the U.S. Government's fiscal year (October 1 through September 30) when used in a planning context.

trees (three trees/acre >16 in. dbh), and number of snags (three trees/acre >9 in. dbh). The NPNFs do not have any postharvest canopy closure data for harvested stands. However, it is projected that while minimally suitable canopy closure conditions may not be achieved across all portions of all harvest units, suitable roosting habitat will be provided where residual leave trees are being left in small clumps or buffer strips. In these critical leave areas, canopy closures are expected to meet minimally suitable levels. Minimally suitable habitat conditions are generally not present in stands harvested over the last 5 years by clearcut or shelterwood harvesting. However, Krusic *et al*. (1996) suggest that small clearcuts in eastern forests can benefit bats as long as mature forests are maintained for roosting and foraging.

Focal Analysis

Any activity that alters Indiana bat habitat suitability can affect habitat beyond the stand or project area level. Implementation of an action that alters a timber stand may be determined to reduce one or more habitat components below suitable levels within the stand but only represent a very small percentage on the landscape. As Erickson and West (1995) stated, "Because bats are highly mobile animals, restricting the interpretation of habitat selection to the stand level will limit our understanding of bat habitat associations. Consideration must also be given to the influence of the surrounding landscape."

The USFS evaluated Indiana bat summer habitat on a larger landscape scale using focal analysis (refer to Appendix D of the BA for a description of this Geographic Information System analysis tool). To evaluate potential Indiana bat habitat across the scale of the entire NPNFs, the USFS divided the forests into square, approximately 2-ac, tracts (300 ft. per side). Each tract was evaluated for the percent of national forest land in North Carolina in the surrounding 8,000 ac. (in a 2-mi-radius circle) that met certain habitat criteria. Callahan (1993) used a 1.9-mi-radius circle to assess habitat conditions around summer maternity sites in Missouri. This analysis of Indiana bat summer habitat conditions on the NPNFs allows for analysis at multiple scales (from 2 ac. to the landscape level).

Using the variables detailed above (forest types potentially suitable for Indiana bat habitat, optimal density of live 9 in. dbh potential roost trees, optimal density of live 16-in. dbh potential roost trees, optimal percent canopy cover, suitable density of dead 9 in. dbh potential roost trees) the USFS was able to tabularly and graphically display the distribution of Indiana bat habitat across the NPNFs (Appendix D of the BA). They were also able to evaluate future potential Indiana bat habitat by conducting the same analyses with the habitat conditions that will exist when the stands are 5 years older.

Suitable forest types: The numerical value assigned to each 2-ac tract is the proportion of national forest land in a 2-mi radius that has suitable forest types. For both the NPNFs, the distribution of these values is strongly skewed to the right, suggesting a high density of tracts with suitable forest types in most areas (Figure D-2b in the BA). The mean value is 0.90 for the Nantahala and 0.86 for the Pisgah (i.e., the average 2-ac. tract has about 86%-90% of the national forest land in a 2-mi radius in suitable forest types). The range of values around the mean for both forests is narrow (the standard deviation is 0.13 for the Nantahala and 0.18 for the Pisgah). About 447,000 ac. on the Nantahala (of 520,000 total ac; 86%) and 423,000 ac. on the Pisgah (of 497,000 total acres; 85%) fall within +/- one standard deviation of the mean. This suggests that most 2-ac tracts on both forests are surrounded by suitable forest types. A spatial display of values also shows a fairly uniform distribution across the landscape (Figure D-2a in the BA).

Live 9-in. dbh potential roost trees: The value of each 2-ac tract is the proportion of national forest land in a 2-mi radius that meets the criteria for defining optimal density of live 9-in. dbh potential roost trees. For both the NPNFs, the distribution of these values is skewed to the right, suggesting a relatively high density of tracts with optimal density of live 9-in. dbh trees in most

areas (Figure D-3b in the BA). The mean value is 0.78 for the Nantahala and 0.80 for the Pisgah (i.e., the average 2-ac tract has about 78%-80% of the national forest land in a 2-mi radius with an optimal density of live 9-in. dbh trees). The range of values around the mean for both forests is relatively narrow (the standard deviation is 0.14 for the Nantahala and 0.17 for the Pisgah). About 410,000 ac. on the Nantahala (of 520,000 total acres; 79%) and 374,000 ac. on the Pisgah (of 497,000 total acres; 75%) fall within +/- one standard deviation of the mean. This suggests that most 2-ac tracts on both forests are surrounded by a large amount of land with optimal density of live 9-in. dbh trees. This conclusion is supported by the spatial distribution of values across the landscape (Figure D-3a in the BA). An estimation of potential change in the next 5 years shows that values for this variable will experience almost no change. The mean values will remain the same, as will the frequency distribution curves (Figure D-3d of the BA), and the spatial distribution will have only minor, localized changes (Figure D-3c in the BA).

Live 16-in. dbh potential roost trees**:** The value of each 2-ac tract is the proportion of national forest land in a 2-mi radius that meets the criteria for defining optimal density of live 16-in. dbh potential roost trees. For the Nantahala, these values exhibit a normal distribution, while values for the Pisgah are slightly skewed to the right (Figure D-4b of the BA). The mean value is 0.50 for the Nantahala and 0.64 for the Pisgah. The range of values around the mean is close to what would be expected with a normal distribution (the standard deviation is 0.15 for the Nantahala and 0.19 for the Pisgah). About 346,000 ac. on the Nantahala (of 520,000 total acres; 67%) and 331,000 ac. on the Pisgah (of 497,000 total acres; 67%) are within +/- one standard deviation of the mean. This suggests that two-thirds of all 2-ac tracts on both forests are surrounded by moderate amounts of land with optimal density of live 16-in. dbh trees (35%-65% of national forest land in a 2-mi radius on the Nantahala and 45%-85% on the Pisgah). The remaining one-third of the 2-ac tracts are evenly distributed at high and low values on the Nantahala and are skewed toward higher values on the Pisgah. These patterns can also be seen in the spatial distribution of values (Figure D-4a in the BA). An estimate of potential change in the next 5 years shows that frequency distribution curves and spatial distribution both shift toward higher values (mean values increase to 0.62 [up 0.12] for the Nantahala and 0.72 [up 0.12] for the Pisgah] (Figures D-4c, D-4d in the BA).

Canopy cover: The value of each 2-ac tract is the proportion of national forest land in a 2-mi radius that meets the criteria for defining optimal percent canopy cover. For both the NPNFs, the distribution of these values is moderately skewed to the right, suggesting a moderately high density of tracts with an optimal percent canopy cover in most areas (Figure D-5b in the BA). The mean value is 0.70 for the Nantahala and 0.71 for the Pisgah (i.e., the average 2-ac tract has about 70%-71% of the national forest land in a 2-mi radius with an optimal percent canopy cover). The range of values around the mean for both forests is slightly wider than that for live 9-in. dbh trees (the standard deviation is 0.14 for the Nantahala and 0.17 for the Pisgah). About 378,000 ac. on the Nantahala (of 520,000 total acres; 73%) and 356,000 ac. on the Pisgah (of 497,000 total acres; 72%) fall within +/- one standard deviation of the mean. This suggests that most 2-ac tracts on both forests have an optimal percent canopy cover on over half the national forest land within a 2-mi radius. This conclusion is supported by the spatial distribution of values across the landscape (Figure D-5a in the BA). An estimation of potential change in the next 5 years shows that frequency distribution curves and spatial distribution both

shift very slightly toward higher values (mean values increase to 0.74 [up 0.04] for the Nantahala and 0.76 [up 0.05] for the Pisgah) (Figures D-5c, D-5d in the BA).

Dead 9-in. dbh potential roost trees: The value of each 2-ac tract is the proportion of national forest land in a 2-mi radius that meets the criteria for defining suitable density of dead 9-in. dbh potential roost trees. For both the NPNFs, the distribution of these values is moderately skewed to the right, suggesting a moderately high density of tracts with optimal density of dead 9-in. dbh trees in most areas (Figure D-6b in the BA). The mean value is 0.70 for the Nantahala and 0.75 for the Pisgah (i.e., the average 2-ac tract has about 70% to 75% of the national forest land in a 2-mi radius with an optimal density of dead 9-in. dbh trees). The range of values around the mean for both forests is slightly wider than that for live 9-in. dbh trees (the standard deviation is 0.13 for the Nantahala and 0.17 for the Pisgah). About 361,000 ac. on the Nantahala (of 520,000 total acres; 69%) and 361,000 ac. on the Pisgah (of 497,000 total acres; 73%) fall within +/- one standard deviation of the mean. This suggests that most 2-ac tracts on both forests have an optimal density of dead 9-in. dbh trees on over half the national forest land in a 2-mi radius. This conclusion is supported by the spatial distribution of values across the landscape (Figure D-6a in the BA). An estimation of potential change in the next 5 years shows that frequency distribution curves and spatial distribution both shift very slightly toward higher values (mean values increase to 0.75 [up 0.05] for the Nantahala and 0.77 [up 0.02] for the Pisgah) (Figures D-6c, D-6d in the BA).

Habitat capability index: The value of each 2-ac tract is the average of the values derived for three of the above variables--live 16-in. dbh potential roost trees, canopy cover, and dead 9-in. dbh potential roost trees. Therefore, rather than directly representing a proportion of national forest land in a 2-mi radius, this value is an index of habitat capability within a 2-mi radius, ranging from zero to 100. The distribution of these values is slightly skewed to the right, somewhat more so for the Pisgah than for the Nantahala (Figure D-7b in the BA). The mean value is 63 for the Nantahala and 70 for the Pisgah. The range of values around the mean is slightly wider for the Pisgah than for the Nantahala (the standard deviation is 11.2 for the Nantahala and 16.6 for the Pisgah). About 377,000 ac. on the Nantahala (of 520,000 total acres; 73%) and 361,000 ac. on the Pisgah (of 497,000 total acres; 73%) fall within +/- one standard deviation of the mean. This suggests that most 2-ac tracts on both forests have values over 50 and that values on the Pisgah are generally slightly higher than on the Nantahala (Figure D-7a in the BA). An estimation of potential change in the next 5 years shows that frequency distribution curves and spatial distribution both shift very slightly toward higher values (Figures D-7c and D-7d in the BA). The mean value changes to 70 (up 7) for the Nantahala and 74 (up 4) for the Pisgah.

The maps of the focal analysis display the spatial distribution of values calculated by the focal mean function (as described in Appendix D of the BA). Areas that display as 90%-100% are uniformly surrounded by habitat that meets the specified requirements. Likewise, areas that display as 0%-9% have essentially no habitat on national forest land within a 2-mi radius that meets the specified requirements.

In summary, there are about 490,000 ac. on the NPNFs that could provide optimal foraging habitat, optimal live potential roost trees, and suitable dead potential roost trees for the Indiana bat, all on the

same acre. This includes 182,000 ac. of cove forests, 287,000 ac. of upland hardwood forests, and 21,000 ac. of yellow pine-hardwood forests. This represents about one-half of all acres on the NPNFs and over one-half of the forest types considered suitable for the Indiana bat (Appendix D). These estimates of habitat capability are conservative because they require each acre to provide all the components of Romme *et al.* (1995) habitat suitability model at levels above suitable.

Suitable Indiana bat foraging and roosting habitat, given the parameters that are measurable, appears abundant and well dispersed across the NPNFs, and though there are several contiguous blocks of land greater than 1,000 ac. in size that are not suitable for the Indiana bat due to either unsuitable forest types (e.g., spruce-fir forests or young forests that have insufficient live or dead potential roosting habitat), the USFS's focal analysis of landscapes on the NPNFs showed that on the Nantahala National Forest, forest stands on over 400,000 ac., are surrounded by at least the same proportion of optimal forage, optimal live potential roost habitat, and suitable dead tree roost habitat as that found at the one known maternity roost site. On the Pisgah National Forest, there are more than 386,000 ac. in this condition (Figures 7a, 7b, and 8 of Appendix D in the BA). In addition, very few areas on the NPNFs would be considered unsuitable for Indiana bats due to the long distances they would have to travel to get to open water or riparian habitats, because average stream density exceeds 8.8 mi. per sq. mi.

EFFECTS OF THE ACTION

Under section 7(a)(2) of the Act, "effects of the action" refers to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action. The Federal agency is responsible for analyzing these effects. The effects of the proposed action are added to the environmental baseline to determine the future baseline, which serves as the basis for the determination in this Opinion. Should the effects of the Federal action result in a situation that would jeopardize the continued existence of the species, we may propose reasonable and prudent alternatives that the Federal agency can take to avoid a violation of section 7(a)(2). The discussion that follows is our evaluation of the anticipated direct and indirect effects of implementing the current Forest Plan. Indirect effects are those caused by the proposed action that occur later in time but that are still reasonably certain to occur (50 CFR 402.02). We have determined that there are no interrelated (an activity that is part of the proposed action and depends on the proposed action for its justification) or interdependent (an activity that has no independent utility apart from the action under consultation) actions apart from the action under consideration.

As mentioned above, there are no standards and guidelines designed specifically to identify, protect, maintain, or enhance summer or winter Indiana bat habitat or prevent impacts to Indiana bats roosting in trees. This makes Indiana bats and their habitat, particularly any maternity sites, vulnerable to take and habitat alteration due to the implementation of land management activities that result in the removal of trees. However, impacts to Indiana bats resulting from land management activities (e.g., timber harvesting) may be reduced through implementation of the current Forest Plan standards and guidelines specific to those activities (Appendix A).

Potential Beneficial Effects

Some activities that have associated negative impacts may also have commensurate beneficial effects. Management practices that create small forest openings may foster the development of suitable roosting and foraging habitat (Krusic and Neefus 1996). Activities that involve tree removal, which could adversely affect roosting habitat, may at the same time improve foraging and/or roosting habitat conditions by opening the canopy and exposing potential roost trees to a greater amount of sunlight (see thermoregulatory needs in "Summer Habitats"). Romme *et al*. (1995) reported that stands with closed canopy conditions (>80% canopy closure) provide less than optimal roosting habitat conditions. Selective timber harvesting treatments that reduce canopy closure levels to <80% may enhance Indiana bat roosting habitat. Callahan (1993) stated that manmade disturbances unintentionally made nine maternity roost trees suitable for Indiana bats. These were in areas that had been heavily logged within the past 20 years and had been used as a hog lot in recent years. Callahan also stated, "those activities probably benefitted Indiana bats by removing most of the canopy cover and leaving behind many standing dead trees." Gardner *et al.* (1991b) found that the selective harvesting of living trees did not directly alter summer roosting habitat. The development of infrequently used or closed logging roads and small wildlife openings may improve foraging habitat conditions by providing narrow foraging corridors within a larger network of mature closed canopy forest.

There are several standards and guidelines in the Forest Plan that conserve Indiana bat habitat, and these safeguards will provide future protection if implementation of the Forest Plan is continued. For example, during the last 5 years of implementation of the Forest Plan, several caves that may support future hibernacula have been protected through gating; this protection will continue in the future. The Forest Plan also includes measures that maintain, protect, and restore Indiana bat foraging and nursery habitat. USFS land allocation establishes over 730,000 ac. of land not suited for timber production, including riparian areas, old-growth patches, wilderness, and special interest areas. In these areas, habitat suitability for the Indiana bat will improve in the future as the number of acres >70 years in age increases.

Specifically, the USFS has identified the following activities as having potentially beneficial effects to the Indiana bat:

1. Vegetative treatments applied in potentially suitable forest types that reduce dominant canopy closures to 60%-80% for roosting habitat (50%-70% for foraging habitat) while maintaining a distribution of larger-diameter dead and live potential roost trees across the landscape.

2. Vegetative treatments that create a mosaic of small canopy gaps that allow sunlight to penetrate the forest.

3. Managing at least 70% of the NPNFs as unsuitable for commercial timber production, which should increase the availability and distribution of older-aged forested stands.

4. Managing for a network of small, medium, and large old-growth patches across the NPNFs.

5. Maintaining functioning riparian ecosystems that provide an abundance of large-diameter hardwoods, large standing snags and den trees, and widely dispersed small canopy gaps.

6. Vegetative treatments that maintain a distribution of small (less then 2 ac.) and linear open grassy habitats as foraging habitat across the NPNFs.

7. Prescribed burning that, when applied, results in a reduction in 2-5 in. midstory and understory saplings.

8. Vegetative treatments that reduce stand stocking levels in young regeneration units and that promote the development of larger-diameter hardwoods.

9. Vegetative treatments that promote and/or maintain oak as a dominant species in mature stands.

Potential Direct Effects of Proposed Actions

Actions that may result in direct impacts to Indiana bats include commercial timber-harvesting activities, timber-salvaging activities, development and management of recreation sites, road construction and reconstruction, trail construction, fuel wood harvesting, wildlife and fishery habitat management, special uses, forest pest management, prescribed burning, site preparation burning, wildland fire suppression, felling of snags to address public safety, and forest products permits. All of the above actions may involve the removal of trees >3 in. dbh, which may negatively affect the Indiana bat through the slight chance that individuals or small groups of roosting bats could be killed by the intentional felling of healthy trees harboring undetected roosts (e.g., dead limbs with loose bark or small cavities in the boles) or the felling of occupied snags or damaged or hollow trees. Between April 15 and October 15, it is possible that one or more Indiana bats could be roosting in trees removed, potentially resulting in the death of an individual(s). The likelihood for "taking" individual bats is dependent on the time of year when the activity occurs and is commensurate with the scope and magnitude of the activity. The potential for removing trees occupied by roosting females and young that are unable to fly is most pronounced after May 1 and before August 15. For projects involving the removal of small numbers of potential roost trees on a small scale, this likelihood is low. Projects involving the removal of suitable roost trees on a larger scale increase the risk of directly harming individual bats.

However, because bats are highly mobile, it is unlikely that a falling tree would result in a bat being killed. Both the sound of a chain saw and the vibration of a saw blade on a tree bole would likely alert the bats and they would simply fly to another roost. This illustrates the low probability of a bat being killed but shows that the bats could be harassed (also a form of "take" (see take definition in "Incidental Take") and stresses the importance of maintaining a sufficient number of snags to provide multiple roost sites (see "Summer Habitats"). Further, Gardner *et al.* (1991a) found that timber harvest activities neither directly damaged known roosts nor discouraged bats from continuing to forage in harvested areas in Illinois.

Potential Indirect Effects of Proposed Actions

Any actions that result in the modification or removal of potential roost trees, or roost trees not in use[8], may adversely impact the quality and availability of summer roosting habitat. Removing potential or unoccupied roost trees may occur through the actual felling or removal of trees during actions that clear forests, burning of trees during prescribed burning activities, and modifying surrounding forest habitat conditions to the point where trees that are left standing are no longer suitable for use by bats.

Indirect effects common to timber harvest activities

When potential roosting habitat is removed by timber-harvesting operations, these effects are most often temporary (<40 years). If posttreatment harvest conditions maintain minimally suitable summer roosting conditions, the effects from the loss of potential or actively used roost trees would be minimized. Humphrey *et al.* (1977) suggested that previously used summer roosts may be important to the reproductive success of local Indiana bat populations. If these roosts are lost or unavailable, adult females may be faced with finding suitable maternity sites at a time when they are already stressed from posthibernation migration and the increased metabolic energy costs of pregnancy. While the Indiana bat appears to be an adaptable mammal, the available literature clearly indicates that it is essential that a variety of suitable roosts exist within a colony's occupied summer area to ensure the continuance of the colony in that area (Kurta *et al.* 1993; Callahan *et al.* 1997). A few maternity colonies, including the first discovered maternity roost site in Indiana, were found when a tree was cut down and the bats moved to another tree (Service 1999f).

Suitable Indiana bat habitat may also be altered in the long term through the conversion from a potentially suitable forest type to an unsuitable forest type (i.e., clearing an upland hardwood site and planting/managing for white pine). As with other "stand level" activities, it is also possible for the impacts to extend to the landscape level.

Effects of timber harvesting for stand regeneration, improvement, salvage, and other activities limited in scope

The harvesting of standing mature, moderately closed-canopy forest for commercial purposes has the potential for having the greatest impact on the quality and availability of suitable Indiana bat summer habitat, both at the stand and landscape scale.

1. <u>Even-aged Regeneration Systems</u>

[8] Recent studies have shown that Indiana bats occupy a number of roost sites within a maternity colony area. Bats reportedly move from one roost to another within a season, in addition to changing roosts in response to changes in environmental conditions. Therefore, it is possible to remove an important roost site while the bat is simply in another portion of its home range.

(a) Clearcut - Stand-level Scale: This type of regeneration/harvest is applied to stands selected for final harvest and regeneration, where optimal conditions requiring regeneration exist that meet the USFS's guidelines, and where the clearcut harvesting system may be appropriate.

Areas regenerated using even-aged management (i.e., clearcut and shelterwood final removal harvesting) have the highest potential for creating less than suitable roosting and foraging habitat conditions for the Indiana bat. In stands harvested by this method, the quality of foraging and roosting habitat would most likely be reduced below habitat suitability threshold levels for at least three of the four habitat criteria (see USFS Assessment of Current Habitat Conditions for the Indiana Bat on the Nantahala and Pisgah National Forests). However, any resulting reduction in foraging and roosting habitat quality or quantity would be partially mitigated by implementing the existing Forest Plan standards and guidelines that call for retaining clumps of standing live trees (most often consisting of Class I and II trees, see "Summer Habitat Model") and retaining minimal numbers and appropriate size snags, existing and potential den trees, and riparian zones or stream-side management. Projected reductions in summer habitat quality will be temporary (<40 years) and small in scope (clearcut units average approximately 20-25 ac.).

The potential exists for unknown, actively used summer roost trees to be removed, resulting in a net reduction in the availability of potentially suitable roost trees. However, snags and residual live roost trees left within harvested units (left singly or in clumps), as well as an abundance of potential roost trees available in riparian areas, old-growth patches, and adjacent untreated stands, should provide an ample amount of potential roost sites close to harvested stands.

Landscape Scale: The Forest Plan projects about 235 ac. per year would be regenerated using this system. The actual acres treated have averaged about 120 ac. per year, with a projected 150 ac. each year being similarly treated from now through 2004 (Table 3). Annually, this treatment only comprises about 0.02% of the forested acres on the NPNFs. Over the remaining 5-year period, this totals 750 ac., or 0.08% of the forested acres--a very small proportion of the landscape. Considering the amount of forested acres across the NPNFs projected to provide more than optimal numbers of potential roost trees and roosting habitat, the potential loss of possible roost trees from clearcut harvesting represents a very small impact.

(b) Shelterwood - Stand-level Scale: On a stand scale, potential impacts to summer roosting and foraging habitat are projected to be similar to those for clearcut harvesting, the difference being that standing live potential roost trees (residual overstory trees) will be retained until a final removal harvest occurs (about 15 to 20 years).

Landscape Scale: The past 6-year harvest figures indicate that the NPNFs are harvesting around 65-70 ac. per year under the shelterwood final removal regeneration method and projects that this will occur on about 50-200 ac. annually over the next 5 years (Table 3). Across the NPNFs, this annually comprises approximately 0.005%-0.02% of the total forested acres. Using this projected annual level of activity, a total of 250-1,000 ac., or 0.03%-0.1% of the forested acres, will be regenerated by this method. Across the NPNFs, the potential loss of

potential roost trees and reduction in potential roosting and/or foraging habitat is considered small.

2. Selection Regeneration Systems

(a) Group Selection and Single-Tree Selection - Stand-level Scale: Group selection and single-tree selection regeneration occurs in small openings. For group selection, these openings are large enough to provide conditions necessary to regenerate tree species that are shade intolerant or intermediate in tolerance. In the Southern Appalachians the diameter of the group opening is defined as one and one-half to two times the mature tree height for the stand. This usually results in openings of 1/4-1 ac. in size, depending on the desired species, tree height, and topography. The resulting stand structure will be uneven-aged, with a mosaic of age-class groups throughout the stand. To eliminate competition with the new age-class, site preparation may include cutting down competing vegetation or treating with herbicides. Single-tree selection results in a series of tree-sized canopy gaps throughout a stand.

Callahan (1993) concluded, from a study conducted of summer maternity colony sites in Missouri, that summer roosting habitat may be enhanced by creating openings around large-diameter snags and mature living trees. The USFS predicts that group selection and single-tree selection regeneration will result in the creation of optimal foraging and roosting habitat by slight to moderate reductions in canopy closure and the creation of small forest openings. Canopy closures would be reduced to within optimal ranges for both foraging and roosting habitat requirements.
The cutting of trees to develop small openings may result in the removal of potential roost trees. However, it is possible that the potential benefits derived from improved general habitat conditions outweigh the loss of individual or small groups of potential roost trees. Over time, as the stand is managed through uneven-aged management, suitable roost trees will be provided within the stand, as well as within adjacent untreated stands. In the USFS's analysis, acres projected to be treated using group selection and single-tree selection have been assumed to represent suitable summer Indiana bat habitat.

Landscape Scale: The Forest Plan projects that approximately 500 ac. will be treated annually using group selection and/or single tree selection regeneration. However, since 1994, these two treatments have comprised about 150 ac. annually, with about the same level of annual use projected for the next 5-year period (150-200 ac. each year) (Table 3). Given the forest types and stand conditions on the NPNFs, single-tree selection is used very little across the NPNFs.

(b) Two-aged Regeneration - Stand-level Scale: With two-aged regeneration treatments, a mature stand is partially cut and a new age-class is established either by natural or artificial methods. The residual overstory is left in place at least until mid-rotation of the new stand (40+ years) or later. With the development and growth of the new stand in the understory, along with the continued growth of the overstory, the stand takes on a two-aged structure. Residual basal areas can range from 15-50 sq. ft. per acre, depending on the management objective.

The removal of live, dominant canopy trees would result in the removal of potential roost trees, with a potential reduction in roosting habitat quality. Stands that have minimal residual basal areas (<15-sq.-ft. basal area) could reduce roosting habitat quality below suitability threshold levels. Snags could be inadvertently knocked down from timber-harvesting operations (from falling trees and by motorized equipment), and some snags could be felled because of safety concerns.

The USFS's analysis assumed that minimally suitable/optimal thresholds would be met for two of the four habitat variables (three snags/acre >8.8 in. dbh and 16 trees/acre >9-in. dbh), 50% of the time for three trees/acre >16 in. dbh), and never for >60% canopy closure. However, the habitat variable for three trees/acre >16 in. dbh can usually be met without adversely affecting stand regeneration and assuming that enough trees of this size are available in the stand prior to harvesting. Suitable foraging and roosting habitat can be maintained by retaining clumps of live potential roost trees of Class A or B trees (Class A snags with >25% exfoliating bark; Class B snags with 10% to 25% exfoliating bark) (Romme *et al*. (1995); retaining all, or a minimum of, three snags per acre; retaining some larger-diameter snags within clumps of live potential roost trees; and leaving all den trees >12 in. dbh.

While the optimal percent canopy closure may not be achieved throughout the stand, the potential impacts can be minimized both in the short and long term. Suitable or optimal canopy closure conditions can be provided throughout treated stands within individual clumps of leave trees, within key wildlife leave areas, and in riparian areas, which will provide a distribution of suitable roosting habitat conditions dispersed throughout treated stands. Retaining an average basal area of 10-30 sq. ft. translates roughly to a canopy cover of 12%-35%. The releasing of residual trees, achieved through the opening of the canopy, is projected to stimulate growth, increase crown development, and increase canopy cover conditions within 5 years following treatment.

Additionally, ranger districts on the NPNFs indicate that unless there is a clearly demonstrated public safety concern, snags are generally left standing within two-aged units. No net reduction in the availability of snags within two-aged shelterwood units is projected. Existing standards and guidelines also provide a framework and direction for creating snags whenever snag standards are not being achieved.

Conversely, it is recognized that due to site conditions and a need to achieve other resource objectives, some stands treated by the two-aged regeneration method may not maintain minimally suitable threshold levels for the four habitat variables (three snags per acre >8.8 in. dbh, an optimal density of live 16-in. dbh potential roost trees, a suitable density of dead 9-in. dbh potential roost trees, and an optimal percent canopy cover). This could result in a potential reduction in summer roosting and foraging habitat at the stand level. However, these habitat elements will be available within leave areas, riparian/stream-side management zones, old-growth patches, and adjacent mature unharvested stands.

Landscape Scale: The Forest Plan projected that 2,532 ac. would be regenerated annually using the two-aged regeneration method (i.e., two-aged shelterwood). However, only about 600 ac. annually have been treated using this method (0.06% of total forested acres) (Table 3). The USFS projects that between 600 and 2,500 ac. per year will be regenerated over the next 5-year period (0.06%-0.25% of total forested acres). At the projected Forest Plan levels, this would constitute less than 0.3% of total forested acres. Over a 5-year period, and under the most liberal scenario (i.e., projected Forest Plan level), acres regenerated by two-aged regeneration would comprise less than 1.3% of total forested acres.

3. Thinning - Stand-level Scale: During the last 6-year period, approximately 535 ac. have been thinned, with an expected 500-1,000 ac. of thinning to occur annually during the next 5 years. The purpose of this treatment is to reduce stand density in immature stands, primarily to recover potential mortality and/or to improve growing conditions for residual trees. Thinning operations may be commercial or noncommercial.

   Potential effects resulting from this treatment are similar to those previously discussed for group selection and single-tree selection. This treatment may remove individual trees, which could otherwise have provided roosting habitat. However, this treatment results in a stand condition that will continue to supply suitable and/or optimal habitat conditions. At a landscape scale, thinnings likely result in an insignificant loss of potential roost or foraging habitat and should result in an increased growth of residual trees, which would produce larger-diameter dominant canopy trees at a greater rate than if the area had not been thinned.

4. Timber Harvest for Salvage and Other Purposes - Stand-level Scale: Timber salvage is for recovering value from timber damaged from the weather and insect (i.e., southern pine beetle, other boring insects, and gypsy moths) and disease infestations. Typically, weather damage is a result of high-wind events, ice storms, and snowstorms. Disease infestations include oak decline and root diseases. Other activities include clearing of road rights-of-way.

   Most often, the dominant canopy overstory has already been substantially modified by some timber-damaging event. However, the impacts of salvage activities may be lessened by the intensity of the salvaging operation. Timber salvage usually consists of the retrieval of commercially valuable trees that are dead and standing, dead and downed, and/or standing live trees determined to be damaged to the point where they are not predicted to persist through the stand rotation. Standing dead trees have a high potential and desirability to serve as immediate bat roosting trees[9], while damaged standing trees represent trees with a high potential for providing future roosting habitat. Further, for those stands where the overstory has already been severely damaged, any additional removal of standing live trees could further reduce stand conditions to below suitable threshold levels for all four habitat variables (three snags per acre >8.8 in. dbh, an optimal density of live

[9] Pines killed by bark beetles have only limited and temporary potential as roosting sites because the bark falls off the trees within a few months of the beetle attack.

16-in. dbh potential roost trees, a suitable density of dead 9-in. dbh potential roost trees, and an optimal percent canopy cover).

The potential magnitude of these unplanned events is quite variable and could occur over large portions of the landscape. Large-scale late winter snow and ice events could impact extensive areas across the NPNFs. However, even under the most accommodating conditions for removal, and given the difficulty in securing economically feasible access, a very low percentage of the timber would ever be retrieved through timber salvaging.

Natural catastrophic events and/or subsequent limited timber salvaging activities, would most likely enhance foraging habitat conditions (create openings), due to a greater abundance of insects. Several studies have documented insect abundance to be higher in clearings than in surrounding habitats (Lunde and Harestad 1987; de Jong 1994).

A potential problem without some salvage operations is that natural catastrophic events, which damage extensive timber acreage, usually result in substantial increases in forest-floor fuel loading. This, of course, can increase the risk and potential severity of wildfires. Subsequent wildfires that are rapidly moving and intense would likely result in extensive damage to stands and a reduction in Indiana bat roosting habitat (the fires would consume the roost trees).

Landscape Scale: While projecting timber harvest levels associated with timber-salvaging and other activities is impossible, records for the last 6 years indicate that the NPNFs have been salvaging timber on about 600 ac. per year (about 0.06% of the total forested acres). On a landscape scale, this represents a very small impact on the availability of summer roosting and foraging habitat across the NPNFs.

5. Activities That Require Limited Removal of Standing Timber - Site-level Scale: Activities that may involve the small-scale clearing of mature forests include road rights-of-way, road widening or reconstruction, trail construction, recreation site construction, road easements, special use permits, construction of wildlife openings, and landline surveying. These activities could potentially remove roost trees and convert potentially suitable roosting habitat to unsuitable nonforested habitat, depending on the specific activity. The potential impacts to summer roosting habitat can be, and often are, mitigated by the retention of larger-diameter trees within recreation sites, within wildlife openings, and at recreational facility sites. While there is a potential for the loss of roost trees, roosting and foraging habitat conditions may be ultimately improved through the development of long linear foraging corridors, small grass-covered openings, and the increase in sunlight to roost trees adjacent to the open areas. The cutting of snags within recreation sites, along road rights-of-way, and other high public use areas where the risk to public safety is elevated could remove potential roost trees.

   Depending on the type of road and level of activity, increased motorized activity could have an adverse impact on maternity colonies. Gardner *et al.* (1991a) reported that the spatial relationships of roost trees to roads (paved or unpaved) and streams may predetermine their suitability as roost

trees. Colonial (>five bats) maternity roosts occupied by pregnant or lactating adult females occurred at least 1,477 ft. (mean = 4,882 ft.) from paved roads.

Landscape Scale: These activities are limited in scope and collectively represent a very small loss of potential roosting habitat. The USFS projects that, collectively, these activities could comprise 200-320 total acres annually. Outside the risk of felling roost trees occupied by Indiana bats, the amount of habitat potentially affected annually comprises less than 0.035% of the total forested area on the NPNFs and likely represents an insignificant impact on Indiana bat habitat.

6. Public Fuelwood Harvesting - Site-level Scale: The NPNFs issue permits to the public to cut dead trees next to open roads. Most ranger districts only permit cutting downed dead trees. However, at least two ranger districts permit the limited cutting of standing dead trees. Most often, this activity occurs next to existing access roads. The harvesting of downed dead trees will have no effect on Indiana bats. The cutting of standing dead trees within areas next to roads could remove suitable roost trees. Depending on the level of activity, intense public fuelwood harvesting could, on a localized scale, substantially reduce snag availability.

   Landscape Scale: Public fuelwood cutting is projected to occur on about 100-200 ac. annually. Given the large number of projected potential roost trees across the NPNFs, the likelihood is extremely low that this activity could ever achieve the magnitude that would result in a significant loss of summer roosting habitat. Demand for public fuelwood has been declining and is projected to remain low, with only localized public interest.

Prescribed Burning, Wild Fire Suppression, and Site Preparation Burning

1. Fuel Reduction, Wildlife Habitat Enhancement Burns, and Growing-season Stand Replacement Burns - Site-level Scale: Fuel reduction and wildlife habitat enhancement burns are primarily relatively cool-burning, dormant season burns, normally conducted between October 15th and April 15th. These burns pose little risk to bats, because maternity colonies and solitary roosting bats have abandoned summer roosting sites by early October. They generally do not reoccupy summer roosting sites until at least mid-April. However, it is remotely possible that Indiana bats could be roosting in trees within a prescribed burn unit in early October and late April. Heat, smoke, or flames from the burn could disturb roosting bats and cause them to fly to another roost outside the burned area.

   Growing-season stand replacement burns occur from late spring through the summer, primarily for regenerating/restoring fire dependent yellow pine communities (pitch pine or table mountain pine and mixed oak species). Burn prescriptions typically call for more intense burning conditions, to the point of causing moderate to extensive tree mortality, which is required to meet restoration objectives.

   Prescribed burns could consume standing snags, thus removing potential roost trees. Living trees suitable as roosts could potentially be killed from the heat/flames from prescribed fire. While this

may remove potential live roost trees, it is also likely that the fire will increase the availability of snags. Snags could be created either directly by fire mortality or indirectly by making them more susceptible to insect attacks or pathogens (Bull *et al*. 1997). Depending on the tree species, live trees subsequently killed by fire activity would remain as suitable potential roost trees until such a time that peeling/lost bark renders them unsuitable as summer roost sites. Fuel reduction and wildlife enhancement burns are not conducted on the NPNFs while young Indiana bats are unable to fly.

Prescribed burning most often results in some degree of midstory mortality to small-diameter trees and shrubs, producing more open understory conditions. Opening of the midstory may improve foraging and roosting habitat conditions. Individual mortality to live trees would increase the number of snags and create scattered canopy gaps, which would improve roosting habitat quality.

Landscape Scale: The Forest Plan projected a prescribed burning program of around 1,000 ac. per year. The average number of acres burned annually on the NPNFs over the last 6 years has averaged around 1,200 ac. The USFS projects an annual prescribed burning program of 1,000-5,000 ac. The USFS is moving toward larger landscape burns, which could potentially involve a greater amount of Indiana bat habitat at once. The effects (positive and negative) on a landscape scale would be similar to those at the site-level scale.

2. Wildfire Suppression - The primary wildfire season in western North Carolina occurs from around October 15 through May 15. The periods between November 1 through December 15, and March 15 through May 1 have the highest number of wildfires. In years of prolonged summer drought conditions, wildfires can occur at any time, especially in more xeric southerly and southwesterly aspects and on the eastern portion of the Pisgah National Forest. While predicting the number of acres on which wildfires occur each year is impossible, the average is about 96 wildfires, totaling 1,840 ac. Wildfires are usually less than 100 ac. in size and burn longer and more intensely before green-up in the spring.

   If occurring after mid-April and before October 15, the possibility exists that snags being used by roosting bats could be consumed. Live roost trees being used by roosting bats could be killed. It is not known how long or how far female Indiana bats will search to find new roosting habitat if traditional habitats have been destroyed or otherwise rendered unsuitable. If they are required to search for prolonged periods after emerging from hibernation in the spring, this effort may place additional stress on pregnant females at a time when they are already expending significant amounts of energy. However, suitable roost trees (both live and dead) are plentiful throughout the NPNFs.

   Standing snags within the vicinity of fire-control lines could be felled by chainsaws to reduce safety hazards to firefighters and to simplify fire containment. The felling of snags could remove potential roost trees. However, wildfires occurring during the spring and summer months typically create an abundance of additional potential roost sites as trees die from the effects of the fire. Tree mortality usually occurs in relatively small and localized gaps, potentially improving foraging habitat conditions.

3. Site Preparation Burning - Site-level Scale: Site preparation burning is conducted primarily during the mid- to late summer months to enhance the survivability of planted tree seedlings. The standing timber basal area has previously been reduced, either by commercial or noncommercial treatments or from insect or disease outbreaks. Areas may be planted in either conifer or hardwood trees, depending on specific site conditions and resource objectives. Typically, residual live trees remain within treatment units, ranging from 10-40 sq. ft. of basal area. Snags most often exceed three snags per acre but may consist primarily of conifer snags.

   Site preparation burning could remove potential roost trees. However, it is anticipated that such activities will result in at least a short-term net increase in roost trees as scattered residual live trees within the burn units die of the effects of summer fire.
   Landscape Scale: Across the NPNFs, this activity represents a very small portion of the landscape, with likely insignificant impacts on Indiana bat habitat.

   Gypsy Moth Spraying - Since 1994 at least two outbreaks of gypsy moth infestations have occurred on the NPNFs (Yancey County and Jackson County). Integrated pest management principles are used in the management of this moth. Annual trapping programs are conducted to monitor infestation rates. The two previous outbreaks were aerially treated with either Gypcheck, *B.t.*, and pheromone flakes. Gypcheck only affects gypsy moth caterpillars, while *B.t.* can be toxic to a wide range of Lepidopterans and thus could affect the Indiana bat's food base. Pheromone flakes are not a toxic chemical; rather, they work to disrupt mating activities.

   There is no feasible way to predict the likelihood of future outbreaks of gypsy moth infestations in western North Carolina. However, any decision not to treat any future outbreaks increases the likelihood of more extensive defoliation and tree mortality in oak-dominated timber stands. Based on experiences reported in Virginia, West Virginia, and other northern Appalachian States, such outbreaks can result in extensive areas of high tree mortality. While this may initially increase the potential number of dead roost trees and open the area to become better foraging habitat, in the long term, there would be little snag recruitment.

   Riparian-Stream-side Zone Management - Riparian or stream-side management zones are classified as management area 18 in the Forest Plan. The area is to be actively managed to protect and enhance, where possible, the distinctive resource values and characteristics dependent on or associated with these systems. Timber management can only occur in these areas if needed to maintain or enhance riparian habitat values. The riparian ecosystem, unless mapped, is considered to be 100 ft. on each side of perennial streams or around a lake. Large standing trees, snags, den trees, and small canopy gaps should be characteristic to this management area. Canopy closure will most likely vary across the NPNFs but generally will provide suitable, if not optimal, canopy closure conditions. As larger trees fall out of stands, the resulting small canopy gaps should improve roosting and foraging habitat conditions.

   Land Exchanges and Acquisition - On average, about 450 ac. of national forest land is exchanged each year, with about 620 ac. received, for a net gain of 170 ac. An additional 500 ac. per year

are acquired through purchase, bringing the total net increase in land acquired to 720 ac. Without bat surveys of national forest land exchanged, the remote possibility exists that active Indiana bat roost sites are present on the land traded. Should this be the case, the potential exists, once this land is in private ownership, for occupied or potential roost trees to be removed. However, given the amount and distribution of potentially suitable roosting habitat on private and national forest land, and the type of land acquired in exchanges, there is an equal degree of likelihood that the national forest could receive land occupied by roosting Indiana bats. Given the small amount of land exchanged each year, the potential effects from this activity are minimal.

Indirect effects common to all activities at landscape scale

The USFS's analysis of the number of acres classified as "suitable for commercial timber production" indicates that more than 70% of the NPNFs will not be harvested for timber production purposes during the life of the Forest Plan. Additional acres that currently provide potentially suitable Indiana bat habitat classified as "suitable" will not be harvested between now and 2004 due to accessibility and economic concerns.

Of the estimated 970,050 forested acres on the NPNFs, only 0.21% (2,077 ac.) are annually being treated through some type of timber treatments (includes even-aged, uneven-aged, salvaging, and thinning). At this rotation rate, it is projected that a very high percentage of forested stands in the "suitable" timber base will exceed the projected 80- to 120-year rotations specified in the Forest Plan. Even at an 80-year rotation, the USFS's analysis indicates that suitable and optimal habitat conditions will be maintained over most of the forested areas.

Using a worst-case scenario (assuming that leave trees would not be left within regeneration units harvested by clearcutting and shelterwood [which is incorrect, considering the Forest Plan's standards and guidelines] at such a level so as to meet suitability thresholds for percent canopy closure, number of trees >9-in. dbh, and number of trees >16 in. dbh), there would still be more suitable and/or optimal suitable Indiana bat habitat on the NPNFs in 2004 (Table 11).

Table 11. Estimated Suitable/Optimal Indiana Bat Habitat Without Leaving "Leave" Trees

Habitat Suitability Criteria	Optimal/Suitable	Current Condition (acres)	Projected 2004 Timber Management (acres)
16 Trees/Acre and >9 in. dbh	Optimal	804,475 (83.0%)	807,975 (83.3%)
3 Trees/Acre >16 in. dbh	Optimal	565,274 (58.3%)	670,772 (69.1%)
>60% Canopy Closure	Optimal	552,434 (56.9%)	549,293 (56.6%)
3 Snags/Acre >9 in. dbh	Suitable	739,247 (76.2%)	774,908 (80%)

The following activities are not likely to result in any adverse impacts to Indiana bats or potential habitat: timber harvesting in unsuitable CISC forest types (see BA) where no hardwood trees >3 in. dbh are removed/felled; public fuelwood harvesting of downed, dead trees or standing live hardwood trees <3 in. dbh; trail maintenance that does not remove snags or standing live hardwood trees >3 in. dbh; timber stand improvements that do not remove standing live trees >3 in. dbh; landline location/surveying

that does not remove standing live hardwood trees >3 in. dbh; or road maintenance that does not remove standing live trees >3 in. dbh.

Summary of Indirect Effects

The Implementation of management activities that involve the removal of trees >9 in. dbh has the potential for adverse effects by removing potential roost trees and reducing tree density levels and subsequent canopy closure levels, which results in less then optimal or suitable summer roosting or foraging habitat conditions. When these activities occur near known or potential maternity sites, they could result in adverse stress to roosting bats. However, the overall potential impact is somewhat lessened by at least five factors: (1) more than 70% of the NPNFs are exempt from timber harvesting; (2) a very high percentage of the NPNFs are projected to provide at least suitable snag habitat conditions, with a projected increase in the number of acres meeting suitable snag habitat conditions by 2004; (3) at projected timber-harvesting rates, the creation of roosts through annual natural tree mortality will more than offset any subsequent loss of live potential or dead roost trees; (4) the overall age of the NPNFs is rapidly increasing, which indicates that as the Forest gets older there will be a greater number of larger-diameter potential roost trees available; and (5) the existing Forest Plan standards and guidelines appear to provide for more than adequate numbers of potential roost trees.

Timber-harvesting activities may reduce roosting and foraging habitat conditions on portions of regeneration units that are below optimal or suitable levels. However, this is a relatively short-term impact that is partially offset by the Forest Plan standards and guidelines, which prescribe retaining suitable snags, den trees, and potential snags at prescribed levels within timber regeneration units. Timber regeneration units can readily meet suitable or optimal threshold levels for three of four roosting habitat criteria (at least 16 trees/acre >9 in. dbh, at least three snags/acre >8.8 in. dbh, and at least three trees/acre >16 in. dbh). While >60% canopy cover may not be attainable on all regeneration units, minimal canopy closure levels can be provided in clumps of leave trees, which should provide potentially suitable roosting habitat within all units. Suitable foraging habitat will remain on all areas where timber harvesting occurs. Given these factors, the potential exists for the implementation of forest management activities to impact components of Indiana bat summer habitat over portions of the NPNFs, but at least some impacts are offset by gains in habitat components elsewhere on the NPNFs.

The amount and quality of habitats that could support Indiana bats will increase significantly across the NPNFs during the next 5 years. The USFS projects that by the year 2004, an additional 100,000 ac. of optimal foraging and live tree potential roosting habitat and suitable dead tree potential roosting habitat will exist on the NPNFs. Total habitat that could support the Indiana bat would increase from its current level of 490,000 to 590,000 ac., a 21% increase. This increase is a result of an increase in stands exceeding 70 years in age that will be present on the NPNFs by the year 2004.

The distribution of habitats that can support Indiana bats will also improve by the year 2004 due to the increase in acres of optimal and suitable habitats (Figures 7a, 7b, 7c, and 7d and Appendix D of the BA). In 5 years, the average proportion of optimal foraging habitat, optimal live potential roosting habitat, and suitable dead tree roost habitat within all 8,000 ac. landscapes (see “Focal Analysis”) on

the Nantahala National Forest is estimated to be 53% and 65% on the Pisgah National Forest (up from the current levels of 42% and 57%, respectively). This equates to an increase of 150,000+ ac on the NPNFs in landscapes similar to or of higher quality foraging and potential roost habitats than that around the known maternity site. Again, this is a conservative estimate of habitat capability because it is based on the requirement that each acre contain all Indiana bat habitat components at suitable or optimal levels.

Cumulative Effects

Action Area

Cumulative effects include the combined effects of any future State, local, or private actions that are reasonably certain to occur within the action area covered in this Opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act. Additionally, any future Federal, State, local, or private actions that are reasonably certain to occur in the action area, and which are considered in this Opinion, will either be carried out by, or will require a permit from, the USFS; they will, therefore, require compliance with section 7 of the Act. Because the Service is not aware of any future State, local, or private actions that are reasonably certain to occur within the action area and which would not be subject to USFS section 7 review, cumulative effects, as defined by the Act, will not occur and will not be addressed further in this Opinion.

Cumulative Impact of Incidental Take Anticipated by the Service in Previously Issued Biological Opinions

In reaching a decision of whether the continued implementation of activities outlined in the Forest Plan on the NPNFs is likely or is not likely to jeopardize the continued existence of the Indiana bat, the Service must factor into its analysis previous biological opinions issued involving the species, especially for those opinions where incidental take was presented as the number of acres impacted. Although a few previously issued biological opinions involve the loss of riparian corridors or foraging and roosting habitat for the Indiana bat, most involve activities implemented from Land Resource Management Plans on National Forests in the Eastern United States. Additionally, such opinions also involve the potential impact to the largest acreage of Indiana bat roosting and foraging habitat. All previously issued Service biological opinions involving the Indiana bat have been nonjeopardy and include opinions for the Cherokee, Daniel Boone, Ozark and St. Francis, George Washington and Jefferson, Mark Twain, Alleghany, and Ouachita National Forests.

The cumulative impacts of an annual anticipated incidental take of 124,659 ac. (Table 12) on these seven national forests and the potential impact to the Indiana bat was estimated within the context of: (1) the remaining surrounding landscape that provides suitable foraging and roosting habitat for the species, (2) the conservation measures incorporated into a particular management plan to minimize the impact of tree removal, (3) the terms and conditions associated with the reasonable and prudent measures provided by the Service in their nonjeopardy biological opinions for each perspective forest

that minimize the impact of incidental take, and (4) the percentage of the rangewide population that is predicted to be impacted by the proposed actions.

Table 12. Annual Anticipated Incidental Take (Acres) and Estimated Number of Indiana Bats Potentially Affected as Identified in Biological Opinions Previously Issued by the Service Involving Seven National Forests in the Eastern United States.

Forest	Annual Anticipated Incidental Take (Acres)	Estimated Number of Indiana Bats Potentially Affected
Alleghany	13,984[1]	~400
Cherokee	1,300~	~200[2]
Daniel Boone	4,500	~1,600[2]
George Washington and Jefferson	4,500	~300[3]
Mark Twain	38,375	~500
Ozark and St. Francis	19,000[4]	~1,000
Ouachita	43,000	~9
Totals	124,659	~4,009

[1] Five-year average.
[2] MacGregor, personal communication, 1999.
[3] Estimate based on MacGregor's predictions for the number of Indiana bats that may occur on the Cherokee and Daniel Boone National Forests.
[4] This includes hardwoods, pines, and pine/hardwoods, all of which can provide suitable roosting habitat for the Indiana bat.

The USFS's BAs provide convincing evidence that an abundance of roosting habitat will be available to each individual bat that may occur on each national forest, even with the annual incidental take of acreage as outlined in the Service's biological opinions. Further, the 4,009 Indiana bats potentially affected would constitute only about 1.1% of the entire population.

Given: (1) the conservation measures outlined in the Forest Plan, BA, biological evaluation, or recovery strategy developed for the Indiana bat; (2) the additional terms and conditions associated with the Service's biological opinions; (3) the abundance of available roost trees on the seven national forests; and (4) the small percentage of the overall population of the species likely to be affected from the annual anticipated level of incidental take (very little of which is actually likely to result in the death of a bat), the Service believes that potential impacts to the species have been sufficiently minimized to prevent a significant cumulative reduction in population numbers of the Indiana bat from the activities.

Potential Interrelated and Interdependent Actions

An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification (Service and National Marine Fisheries Service [NMFS] 1998). An interdependent activity is an activity that has no independent utility apart from the action under consultation (Service and NMFS 1998). A determination of whether other activities are interrelated to, or interdependent with, the proposed action under consultation is made by applying a "but for" test. That is, it must be determined that the other activity under question would not occur "but for" the proposed action under consultation (Service and NMFS 1998). For example, private timber-harvesting activities outside the NPNFs would only be considered as interrelated or interdependent if a determination was made that these activities would not occur but for implementation of the Forest Plan on the NPNFs. There is no justification for claiming that other tree-harvesting activities on adjacent land occurred due to the implementation of the Forest Plan; therefore, these actions outside the boundaries of the NPNFs cannot be considered as an interrelated or interdependent action that should be considered in this Opinion.

CONCLUSION

After reviewing the current status of the Indiana bat; the environmental baseline for the action area; the effects of forest management and other activities described in the Forest Plan on the NPNFs (both direct and indirect); measures identified in the USFS's BA to assist in the protection, management, and recovery of the species; previously issued Service nonjeopardy biological opinions that allow various levels of incidental take; any potential interrelated and interdependent actions associated with the proposed action; and any potential cumulative effects, it is the Service's biological opinion that forest management and other activities authorized, funded, or carried out by the NPNFs, in accordance with the Forest Plan for the NPNFs, are not likely to jeopardize the continued existence of the Indiana bat. Critical habitat does not occur in the action area; therefore, none will be adversely affected or destroyed by the continued implementation of the Forest Plan.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act prohibit the taking of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns such as breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns that include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited under the

Act, provided that such taking is in compliance with the terms and conditions of this incidental take statement.

Factors Considered in Determining the Amount of Incidental Take

Several factors must be considered in determining the amount of incidental take for this Opinion. Foremost is the likelihood that the species occurs in any particular area and the probability of any particular project impacting an individual. Although the Indiana bat has now been documented in one area on the Nantahala National Forest during the summer, there are few documented occurrences of this species on either the Nantahala or Pisgah National Forests (see "Status of the Species in North Carolina"). Though extensive surveys have not been conducted for this species across the NPNFs, recent (1999) mist-netting/Anabat[10] surveys revealed only the one capture/detection (the Graham County maternity colony) at more than 60 separate survey sites.

Species' Range

The NPNFs are on the extreme southeastern edge of the range of the Indiana bat. In fact, there are relatively few records east of the spine of the Appalachian Mountains. The species' range in North Carolina is based on the four records (over the last 40 to 60 years) detailed above. Before the Graham County, North Carolina, maternity colony discovery, all records were thought to be for hibernating individuals or individuals moving to or from a hibernaculum. Only one Indiana bat has been found (1991) at these four locations in more than 30 years (see "Status of the Species in North Carolina"). The capture of foraging males and reproductive females in Kentucky in 1994 and 1995, the capture of foraging males in West Virginia and Virginia, and the capture of a lactating female in Tennessee[11], have led some to believe that the Southern Appalachians may be more important as Indiana bat summer maternity habitat then previously thought. However, the North Carolina maternity colony is farther south than any previous maternity record and, except for one New Jersey record, is also the farthest east.

Proximity to Hibernacula

The "source" of any Indiana bats on the NPNFs is dependent primarily on the proximity of the NPNFs to winter hibernacula. More than 85% of the rangewide population of 353,000 bats occupy nine Priority I hibernacula (>30,000 bats), all of which are north of North Carolina (Service 1999f), and it is believed that the vast majority of these bats disperse north from these areas, not south, into North

[10] The Anabat system is composed of a bat detector with a broadband microphone (20-200 kHz) and a Zero Crossing Analysis Interface Module (ZCAIM). The ZCAIM converts the sounds detected by the microphone and displays the sounds in a time-frequency representation. The assumption being that each species of bat has a unique "voice print" by which it can be identified. Using the Anabat system in conjunction with mist-netting has been shown to be more effective in documenting a species' occurrence than mist-netting alone (Farrell *et al*. 1999, Murray *et al*. 1999).

[11] A lactating female was captured in Monroe County, Tennessee, on June 30, 1999. Because this bat was captured more than 15 mi. from the Graham County, North Carolina, maternity site, it likely came from a different maternity colony.

Carolina. Caves on the eastern side on the Southern Appalachians in the North Carolina mountains are fissure caverns rather than karst caves and do not provide ideal microclimate conditions for the Indiana bat (Boynton *et al.* 1992). Only one Priority III hibernacula (hibernacula of marginal significance; i.e., 1 to 500 individuals) has been identified in North Carolina (Service 1999f), and no more than four Indiana bats have been recorded in 1 year from this site (see "Status of the Species in North Carolina").

The most likely "source" of Indiana bats that could disperse to the NPNFs is Whiteoak Blowhole Cave (a Priority II hibernaculum) in the Great Smoky Mountains National Park, Tennessee. This cave is about 15 mi. from the western edge and 130 mi. from the eastern edge of the NPNFs. The winter population of Indiana bats at this hibernaculum, though apparently declining (Figure 2), has averaged 7,294 over the last 25 years. A high of 11,287 Indiana bats were counted in 1981, but only 3,084 were found in 1999. While it is likely that most of the bats hibernating in this cave disperse to the north, as in most other areas, the Graham County, North Carolina, maternity site also indicates that probably not all individuals are long-distance migrants, at least not every year (see "Migration").

Assuming that there are approximately 7,294 bats at the hibernacula (25-year average, see Figure 2), that 50% are females, and that there are an average of 25 females at a colony site (again a maximum estimate of the number of colonies, since colonies can have up to 100 individuals), then the Indiana bats at Whiteoak Blowhole Cave would require enough habitat to support probably no more than 146 maternity colonies (7,294 * 0.50/25). Using a 1-mi-radius circle (2,011 ac.) as a conservative estimate of an Indiana bat maternity colony's home range (Gardner *et al.* 1992, Garner and Gardner 1992) and assuming home ranges do not overlap (which is unlikely), it is estimated that a maximum of 293,606 ac. (146 * 2011) of suitable foraging and roosting habitat would be needed for all female bats found at Whiteoak Blowhole Cave. If all of the potential maternity colonies originated from Whiteoak Blowhole Cave migrated to the NPNFs, they would need only 60% of the 490,000 ac. of "optimal"[12] Indiana bat habitat found on the NPNFs. Further, an additional 100,000 ac. are expected to become "optimal" over the next 5 years, a 20% increase by 2004.

It is more likely, however, that dispersal is oriented to the north and not equal in all directions, though there appears to be no shortage of habitat in close proximity to the hibernaculum. There are more than 20 million acres of land in the Southern Appalachians within a 130-mi radius (the distance to the eastern edge of the NPNFs) of Whiteoak Blowhole Cave, of which over a half million acres are between the cave and the NPNFs). While most of this area is private land, there are nearly 3.6 million acres of public land managed by the USFS, National Park Service, State Parks, and the Cherokee Indian Reservation (Table 13) within a 130-mile radius of Whiteoak Blowhole Cave. Further, forests cover 70% of the Appalachian region, while pastures (17.4%), croplands (3.4%), and areas developed for roads, dwellings, and other human structures (3.1%) cover considerably less area (Southern Appalachian Man and the Biosphere Cooperative 1996). Therefore, whether dispersal is oriented to the north or random, the role of NPNFs in providing forested habitat for the Indiana bat is reduced.

[12] There are approximately 490,000 ac. on the NPNFs that could provide optimal foraging habitat, optimal live potential roost trees, and suitable dead potential roost trees for the Indiana bat, all on the same acre.

Table 13. Land Ownership (Acres) Within a 130-Mile Radius of the Whiteoak Blowhole Hibernacula.

total area within a 130-mile radius	33,979,466
total area within the Southern Appalachians	20,059,600
private land	17,245,000
U.S. Forest Service	2,549,348
U.S. Park Service	577,310
State Parks	411,255
Cherokee Indian Reservation	45,420
U.S. Departments of Defense and U.S. Department of Energy	37,510

Migration

Migration is an energy-expensive and hazardous undertaking. Consequently, the benefits must be considerable for a species to undertake such a risk. Migration allows a species to exploit a resource (i.e., food), avoid a negative influence (i.e., predation, harsh weather, parasites), or both[13]. Migration, as a form of dispersal, also enables animals to maintain higher average densities and activity rates (Odum 1971). As mentioned previously, band recovery records indicate that females, and some males, migrate north in the spring upon emergence from their hibernacula (Hall 1962, Barbour and Davis 1969, Kurta 1980, LaVal and LaVal 1980), and most biologists would consider the Indiana bat a migratory species. Therefore, the conditions provided at more northern latitudes must be providing the Indiana bat with a resource (or resources) that is not available, or less available, in southern areas, or the southern latitudes have a negative factor (or factors) that outweighs the risks associated with northward migration.

The recent discoveries of a maternity colony and postlactating females at more southern latitudes during the summer months implies that not all individuals are migratory. If migration has evolved in the Indiana bat so that they are better able to exploit a resource at more northern latitudes, then it is possible for some individuals to be able to not migrate and still exploit the same resource at more southern latitudes because of decreased intra-specific competition. What proportion of the population could remain nonmigratory is likely small or migration would never have evolved as a part of the species' ecology.

Similarly, if there is a negative influence at more southern latitudes, while some individuals may be able to survive and/or reproduce in any given year, the number of individuals that take this risk is likely small and inconsistent from year to year, or, again, migration would never have evolved as a part of the species' ecology. Therefore, it is likely that the vast majority of the individuals do migrate north and the relatively low number of individuals that do not migrate is inconsistent from year to year.

Activities Within Suitable Indiana Bat Habitat

[13] There could also be some genetic benefits from migration but, because the Indiana bat mates during the fall, when it is least dispersed, this seems an unlikely reason to invest in migration. Further genetics work could, however, show that genetic "mixing" is influenced by migration.

The Forest Plan for the NPNFs allocates land for many activities and uses (Table 3). Any activity that removes trees >3 in. dbh could directly or indirectly affect the Indiana bat. Though during the previous 6 years (1994-1999) implementation of such activities was much less than projected, if implementation is carried out at 100% for the remainder of the Forest Plan, about 10,893 ac. would be impacted (including 5,500 ac. of prescribed burning) each year, or about 54,465 ac. during the remaining planning period. Although this overestimates impacts to Indiana bat habitat because it assumes that all activities occur in forest types suitable for the Indiana bat and that all activities are completely deleterious, this would represent only about 11% of the "optimal" habitat (490,000 ac.) that could support this species (see "Focal Analysis"), and only 7% of all forested acres (730,328 ac.). While this would appear to represent a decline in the amount of available habitat, the 437,000 remaining acres of "optimal" habitat would provide enough habitat to theoretically support more than 217 maternity colonies of 25 bats each, 60% more than the maximum number of maternity colonies that would be supported by the population estimates of Whiteoak Blowhole Cave hibernacula bats (see "Proximity to Hibernacula"). Further, the USFS projects that by the year 2004, an additional 100,000 ac. of optimal foraging habitat and live tree potential roosting habitat, as well as suitable dead tree potential roosting habitat, will exist on the NPNFs. This increase results from the increase in stands exceeding 70 years in age that will be present on the NPNFs by the year 2004. Also, many activities, such as thinning and burning, may actually improve foraging habitat for the Indiana bat by opening dense stands that may hamper movement of bats through the stand or improve potential dead-tree roosting habitat by creating new snags.

Prescribed Fire

Growing season prescribed burns may result in the burning of occupied roost trees and there is a slight chance that the smoke generated during prescribed burns could also cause roosting bats discomfort or, in the extreme, death (particularly before young can fly). More likely, however, is that the bats will simply fly away from the disturbance and find another roost, given the estimated number of acres providing suitable roosting habitat and the fact that most colonies have multiple roost sites. Additionally, the creation of new snags probably offsets any roosting habitat losses that are the result of an occasional snag burning. Further, because a dense overstory and understory inhibit bat movement and foraging, prescribed burning will provide restoration and maintenance of an uncluttered, open forest, thus providing foraging pathways and allowing bats to reach roost trees more easily. Increased insect populations produced in burned areas are also likely to occur in the years following prescribed burns.

Summary of Factors to Consider

Since the discovery of the Indiana bat maternity colony in Graham County, North Carolina, in July of 1999, the Service has considered the summer range to include Graham County, North Carolina, and, because of similar habitat, the adjacent counties of Cherokee, Macon, and Swain in North Carolina)[14].

[14] The adjacent counties in Tennessee, which include portions of the Cherokee National Forest, are not considered in this consultation. The Service's Cookeville, Tennessee, Field Office has been and continues to work with the USFS and others in Tennessee regarding the Indiana bat.

The Service believes that this is a reasonable approach to conservatively (erring on the side of the species) estimate the range of a species when extensive surveys have not been conducted, especially on the edge of the species' range.

After a more in-depth analysis of the habitat and the biology of the Indiana bat (particularly the range of the species, migration biology, and the proximity to hibernacula detailed above), the Service continues to believe that these counties in North Carolina--Graham, Cherokee, Macon, and Swain--are the most likely to harbor Indiana bats during the summer months. However, the Service does not exclude the possibility that Indiana bat could occur elsewhere on the NPNFs, though it is likely they would be in very low numbers and principally males. Expanding the summer range farther south and/or east (over 100 mi. if it were to include the entire Pisgah National Forest), without further evidence to indicate the species occurs there, is not reasonable.

There appears to be no shortage of suitable habitat across the NPNFs nor is there any predicted net decline in the amount of suitable habitat over the life of the Forest Plan. On the contrary, because of age of the NPNFs, there will be more suitable habitat at the end of Forest Plan implementation than is now available.

Amount of Take Anticipated

The Service anticipates incidental take of the Indiana bat will be difficult to detect and quantify for the following reasons: (1) individuals are small; (2) Indiana bats form small (i.e., 25-100 individuals), widely dispersed maternity colonies under loose bark or in the cavities of trees and males and nonreproductive females may roost individually; (3) finding dead or injured specimens is unlikely; and (4) the extent and density of the species' summer "population" on the NPNFs is likely small and on the periphery of the summer range.

The measures described below are nondiscretionary and must be implemented by the USFS or become binding conditions of any actions carried out by the USFS or any permit issued to an applicant, as appropriate, in order for the exemption in section 7(o)(2) of the Act to apply. The USFS has a continuing duty to regulate the activity covered by this incidental take statement. The protective coverage of Section 7(o)(2) of the Act may lapse if the USFS (1) fails to adhere to the terms and conditions of the incidental take statement or fails to require applicants to adhere to the terms and conditions through enforceable terms added to permits or grant documents, and/or (2) fails to retain oversight to ensure compliance with these terms and conditions.

Incidental take of Indiana bats is expected to be in the form of killing, harming, or harassing, with the direct killing of Indiana bats being the least likely. While cutting trees during the nonhibernation season for harvest or in preparation for other activities could result in mortality to females and young (especially before the young are able to fly) or to individually roosting Indiana bats, it is more likely that the colony (or roosting individuals) will be forced to find an alternate roost or be forced to abandon a roost in the area. This, in turn, could possibly lead to lower reproduction or survival. Tree harvesting or removal (e.g., associated with road and trail construction or recreational development) may also result in the

alteration of the bats' roosting and/or feeding activities (i.e., the bats may have to fly farther to forage and seek alternate roosts, or they may be forced to abandon the area altogether). In addition, growing-season prescribed fires may result in the burning of occupied roost trees. Smoke generated during prescribed burns could also cause roosting bats discomfort or death. Burning may cause a maternity colony or individual roosting bat to abandon a traditionally used roost tree. Finally, the spraying of large blocks of forested habitat with *B.t.* (or other nontarget pesticides) may reduce prey and cause individual bats to have to travel longer distances to forage.

Monitoring to determine the taking of individual bats within an expansive area of forested habitat is a complex and difficult task. Unless every suitable roost tree is inspected by a trained individual before an activity begins, it would be impossible to know if a maternity colony or roosting Indiana bats were present in a project area. It would also be impossible to evaluate the amount of incidental take of Indiana bats unless a postproject inspection is immediately made of every tree that has been cut or disturbed. Inspecting individual trees is not considered by the Service to be a practical survey method and is not recommended as a means to determine incidental take. However, the level of take of this species can be anticipated by the aerial extent of suitable habitat affected. Although no Indiana bat maternity colony or individually roosting Indiana bats are known to have been incidentally taken on the NPNFs during tree removal or other habitat-modifying activities conducted to date, incidental take of this species can be anticipated due to the loss of active roost trees. The Service believes if a maternity colony or roosting individuals are present in an area proposed for disturbance, loss of suitable roosting habitat would result in the incidental taking of Indiana bats. However, implementation of the terms and conditions associated with the reasonable and prudent measures provided below will significantly reduce the potential for incidental take.

This incidental take statement anticipates the taking of Indiana bats from tree removal associated with timber harvest; road and trail construction and maintenance; recreational site construction; facilities construction; wildlife openings; surveying lines; easements; special use permits; forest products permits; and prescribed burning. Because the Service believes the Indiana bat is not equally distributed across the NPNFs, the incidental take statement addresses two separate areas--(1) Graham, Macon, Swain, and Cherokee Counties, North Carolina, and (2) the remainder of the NPNFs.

As detailed above, Graham, Macon, Swain, and Cherokee Counties, North Carolina, are the most likely to harbor summer-resident Indiana bats, particularly maternity colonies. This four-county area covers 1,170,022 ac., of which 862,848 ac. (74%) are forested. The USFS manages 379,977 ac. in this area, and 158,623 of these acres provide optimal or suitable habitat (>60% canopy cover, at least three snags/acre, at least 16 trees/acre >9 in. dbh, and at least three trees/acre 16 in. dbh or greater) for Indiana bats (Table 14). The USFS estimates that by 2004, an additional 35,820 ac. will provide suitable or optimal habitat (a 23% increase).

Table 14. Acres Providing All Habitat Components Suitable or Optimal for the Indiana Bat in Graham, Macon, Swain, and Cherokee Counties, North Carolina (>60% Canopy Cover, at Last Three Snags/Acre, at least 16 Trees/Acre >9 in. dbh, and at Least Three Trees/Acre 16 in. dbh or Greater).

Forest Grouping	Current Condition	Projected 2004	Estimated Change (acres)	Percent Change
Cove hardwood	64,861	86,005	+21,144	+33%
Upland Hardwood	86,268	98,401	+12,133	+14%
Yellow Pine-Hardwood	7,494	10,037	+2,543	+34%
Total Acres	158,623	194,443	+35,820	+23%

Because there has been virtually no research on Indiana bats focused on nonmigratory or short-distance migrants, some assumptions are necessary to estimate the amount of incidental take. First, it is reasonable to assume that the bats found on the NPNFs have dispersed from Whiteoak Blowhole cave in the Great Smoky Mountains National Park, Tennessee. Second, most literature indicates that the majority of individuals probably migrate north from the cave with only a small percentage likely dispersing a short distance. If: (1) an estimated 10% of the females do not migrate north, (2) there is an average of 7,294 (25-year average) bats using Whiteoak Blowhole Cave, and (3) half of these bats are female, an estimated 365 females a year are nonmigratory (or short-distance migrants). If all of these females joined maternity colonies, with a minimum size of 25, it could be estimated that there are about 15 maternity colonies near Whiteoak Blowhole Cave.

How far these colonies disperse from the hibernacula is problematic, as the only information available is for the Graham County maternity site, which is about 23 mi. from the hibernaculum. Within 40 mi. of the cave (an area of more than 3.2 million acres) three areas are most likely to provide suitable Indiana bat habitat--(1) the four-county area of the Nantahala National Forest, (2) the Cherokee National Forest to the west, and (3) the Great Smoky Mountains National Park to the east. If the estimated 15 colonies disperse equally *only* to these three areas (which would be unlikely), as they are the largest forested tracts in the area, then only an estimated five colonies (125 bats) occur in the four-county area of the Nantahala National Forest. Further, if a 1-mi-radius circle (2,011 ac.) is used as a conservative estimate of an Indiana bat maternity colony's home range (Gardner *et al.* 1992, Garner and Gardner 1992), only an estimated 10,055 ac. (5 * 2011) of suitable foraging and roosting habitat are needed to support the estimated number of maternity colonies in the four-county area (assuming home ranges do not overlap), which is only 6% of the estimated "optimal" habitat available in the four-county area (158,623 ac.). Even if all of the Indiana bat maternity colonies from Whiteoak Blowhole Cave summered in the four-county area, there appears to be enough habitat to support them (see calculations under "Proximity to Hibernacula").

The USFS estimates maximum annual impacts to 4,574 ac. from their activities in the four-county area (Table 15). These activities impact only 0.5% of the forest acres in the four-county area and only 1% of USFS land in the four-county area annually (862,848 ac.). Assuming a worst-case scenario, that all the activities will occur in "optimal" habitat and that all activities will be completely deleterious, this would represent annual impacts to less than 3% of the "optimal" habitat that could support this species in the four-county area (158,623 ac., Table 14). While this would appear to represent a decline in the amount of available habitat if all activities occurred in "optimal" habitat, the 135,753 remaining "optimal" acres alone would provide enough habitat to theoretically support about 68 maternity colonies of 25 bats each, almost half the number of maternity colonies that would be supported by the population estimates of Whiteoak Blowhole hibernaculum bats if no females migrated (see "Proximity to Hibernacula"). Further, the USFS projects that by the year 2004 an additional 35,820 ac. of habitat will provide >60% canopy cover, at least three snags/acre, at least 16 trees/acre >9 in. dbh, and at least three trees/acre 16 in. dbh or greater in the four-county area. Therefore, even if all scheduled activities occurred in "optimal" habitat over the next 5 years, there would still be a net increase of almost 13,000 ac. of "optimal" habitat in the four-county area. Also, many of these activities, such as thinning, may improve foraging habitat for the Indiana bat by opening dense stands that may hamper movement of bats through the stand or improve potential dead-tree roosting habitat by creating new snags and/or increasing the amount of solar radiation reaching new and existing snags.

Table 15. Types and amounts of activities on the Nantahala and Pisgah National Forests in Graham, Macon, Swain and Cherokee Counties, North Carolina.

ACTIVITIES	Estimated for Implementation 2000-2004 Annual Average
Prescribed Fire	Fuel Red. 420-2,100 ac. Wildlife Burns 105-210 ac.
Trail Construction	8-11 mi. 10-13 ac.
Recreation Site Construction	2-4 ac.
Facilities	<½ ac
Regeneration by Selection Method	63-210 ac.
Regeneration by Even-aged Methods	Clearcut 42-57 ac. Shelterwood 21-42 ac.
Regeneration by Two Aged Method	250-1,050 ac.
Timber Harvesting for Salvage and Other Purposes	105-252 ac.
Thinning	210-420 ac.
Road Construction	2-7 mi. 6-22 ac.
Road Reconstruction	15-19 mi. 18-23 ac.
Wildlife Openings Constructed	2-4 ac.
Landline Location and Surveying	6-11 mi. 4-6 ac.
Road Easements	4-13 ac.
Special Use Permits	42-63 ac.
Timber Forest Products Permits	42-84 ac.

The annual incidental take for Graham, Macon, Cherokee, and Swain Counties, as estimated indirectly by acres disturbed, is 4,574 ac.[15] **annually**. This constitutes a maximum of 2.9% of the "optimal" habitat (158,623 ac.) in the four-county area and about 1.3% of the forested acres managed

[15] Though measuring the actual number of Indiana bats that might be "taken" either by killing, harming, or harassing is virtually impossible, it is estimated that this habitat-disturbance level could impact 25-100 Indiana bats per year (one maternity colony).

by the USFS in the four-county area (348,852 ac.). The potential for the loss of suitable/optimal habitat and the consequent incidental taking of Indiana bats, however, is significantly reduced through the implementation of the Forest Plan's standards and guidelines, the terms and conditions associated with the reasonable and prudent measures provided by the Service, and the net increase in optimal and suitable habitat expected over the next 5 years. Further, as mentioned previously, many of these activities, such as thinning, may actually improve foraging habitat for the Indiana bat by opening dense stands that may hamper movement of bats through the stand or improve potential dead-tree roosting habitat by creating new snags and/or increasing the amount of solar radiation reaching new and existing snags.

If levels of incidental take associated with any one of the above-listed activities (Table 15) are exceeded, as measured by the total amount of habitat disturbance, such incidental take represents new information that would require a review of the reasonable and prudent measures provided and could require reinitiation of formal consultation.

On the remainder of the Nantahala National Forest (outside the four-county area detailed above) and the Pisgah National Forest (heretofore referred to as the "remainder of the forest"), the Service does not have evidence that summer populations, specifically maternity colonies, are present. Additionally, the Service believes there are relatively few Indiana bats using the remainder of the forest because: (1) there are only four records for Indiana bats in the last 40+ years in western North Carolina; (2) the area is on the edge of the species' range; (3) there is only one Priority III hibernaculum south of the NPNFs, and no more than four Indiana bats have ever been found there (only one in the past 5 decades); and (4) the area is not between known summer habitat and any Priority I or II hibernacula.

The Forest Plan shows a maximum of 6,198 ac. (0.9%) would be disturbed annually by USFS activities (Table 3 [less values in Table 15]) on the remainder of the forest (about 645,000 ac.). The USFS's analysis of this area indicate that about 474,380 ac. could provide optimal foraging habitat, optimal live potential roost trees, and suitable dead potential roost trees for the Indiana bat, <u>all on the same acre</u>. Assuming a worst-case scenario, that all the activities will occur in an area that provides optimal foraging habitat, optimal live potential roost trees, and suitable dead potential roost trees for the Indiana bat (all on the same acre) and that all activities are completely deleterious, only about 1.3% of this habitat would be affected annually, or about 6% by 2004. While this appears to represent a decline in the amount of suitable and optimal habitat, the 444,260 remaining acres would provide enough habitat to theoretically support almost 700 bats with home ranges (conservatively estimated at 640 ac.) that did not overlap. Further, the USFS projects that by the year 2004 an additional 64,000+ ac of habitat that will provide >60% canopy cover, at least three snags/acre, at least 16 trees/acre >9 in. dbh, and at least three trees/acre 16 in. dbh or greater in the remainder of the forest. Therefore, even if all scheduled activities occurred in optimal or suitable habitat over the next 5 years, and all of these activities made the habitat unsuitable for Indiana bats, there would still be a net increase in Indiana bat habitat.

With the probability that Indiana bats occur on the remainder of the forest being so low and the quantity of habitat able to support them being so high, the probability of any event actually "taking" an Indiana bat, much less the take being detected or measurable, is discountably small. Further, should Indiana bats

be present at an undetectably low level or should they begin using the area in the future, an abundance of suitable habitat will be available even if the Forest Plan is fully implemented. **Therefore, the Service believes that implementation of the Forest Plan outside Graham, Macon, Swain, and Cherokee Counties, at the levels described, is not likely to adversely affect the Indiana bat and an incidental take statement is not needed.** This determination is based on adherence to the Forest Plan. Obligations under section 7 of the Act must be reconsidered if: (1) new information reveals impacts of the identified action that may affect the Indiana bat in a manner not previously considered, (2) the Forest Plan is subsequently modified in a manner that was not considered in this review, (3) new information reveals the Indiana bat is more abundant in the area than is currently believed, or (4) the species is distributed across the NPNFs differently than described in this Opinion.

EFFECT OF THE TAKE

In this Opinion the Service determined that this level of take is not likely to result in jeopardy to the Indiana bat or destruction or adverse modification of critical habitat.

REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize take of the Indiana bat. These nondiscretionary measures include, but are not limited to, current standards and guidelines found in the Forest Plan and the terms and conditions outlined in this Opinion.

1. Proposed management activities shall be planned, evaluated, and implemented consistent with measures developed to protect the Indiana bat, including those designed to maintain, improve, or enhance its habitat.

2. The USFS shall monitor timber sales and other activities on the Nantahala National Forest in Graham, Macon, Swain, and Cherokee Counties to determine if the Forest Plan's standards and guidelines and the terms and conditions of this Opinion are being implemented.

3. The USFS shall monitor distribution and use of the NPNFs by Indiana bats.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the USFS must either conduct mist-netting surveys for the Indiana bat that show the Indiana bat is not present or comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements for actions on the Nantahala National Forest in Graham, Macon, Swain, and Cherokee Counties, North Carolina. These terms and conditions are nondiscretionary.

1. Implement the Forest Plan's standards and guidelines in a manner that will accomplish the following terms and conditions as they apply to timber management practices pertaining to the harvest, regeneration, or stand improvements of suitable forest types (Appendix D), on the Nantahala National Forest in Graham, Macon, Swain, and Cherokee Counties, North Carolina:

   b. Retain standing[16] live trees that have more than 25% exfoliating (separated from the cambium) bark and are greater than 3 in. dbh.

   c. Retain as many shellbark, shagbark, and bitternut (*Carya cordiformis*) hickories as practicable[17], regardless of size or condition (live, dead, or dying).

   c. Retain as many standing[15] snags (greater than 3 in. dbh) as practicable within regeneration and timber treatment units, regardless of species, unless specifically marked for removal[18].

   d. Retain as many hollow, den, or cavity trees greater than 9 in. dbh as practicable[15].

   e. To maintain suitable canopy cover, within 30 feet of intermittent streams, limit openings in the upper canopy to single-tree gaps. Limit the distance between openings to 75 feet. Maintain trees from the Priority Leave Tree Species List (Appendix C) when possible. For intermittent stream crossings (roads, skid trails, etc.), apply the management standards and guidelines used for riparian areas (Management Area 18).

   f. Use Indiana bat summer habitat as a riparian related value[19] for delineation of riparian areas (Management Area 18). Within the first 30 ft. on each side of perennial streams and other permanent water bodies, no standing trees (green, dead, dying, or leaning) shall be removed or felled. Retain a minimum of 60% canopy in the remainder of the riparian area with leave trees being first selected from the Priority Leave Tree Species List in Appendix C. For crossings (roads, skid trails, etc.), apply the management standards and guidelines used for riparian areas (Management Area 18).

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[16] Standing trees are those that are not root sprung.

[17] Practicable is defined, for these term and conditions, as not intentionally removing. The Service recognizes that occasionally individual trees (live, dead, or dying) will be incidentally knocked down or felled and that these acts should not constitute a violation of these term and conditions. Further, the Service realizes that some projects have few or no options for where or when they can occur (rights-of-way, roads, landings) that may require the intentional removal of snags - see Condition 5.

[18] A snag can be marked for removal if it does not provide or is not expected to provide suitable Indiana bat roosting or maternity habitat (i.e., snags <3 in. dbh and snags that have lost all of their bark and do not have any cavities or crevasses for individual bats).

[19] By having Indiana bat considered as a riparian related value, their habitat will receive the emphasis given to riparian area guidance in the Forest Plan - "The area will be actively managed to protect and enhance, where possible, the distinctive resource values and characteristics dependent on or associated with these systems."

g. Designate and retain living residual trees in the vicinity of one-third of all large (>12 in. dbh) snags with exfoliating bark to provide them with partial shade and some protection from wind throw, using the priority trees in Appendix C when possible.

h. Where feasible, design regeneration units with irregularly shaped boundaries so that some uncut live trees project into the regeneration unit.

i. Conduct prescribed burns between October 15 and April 15, when possible. During site preparation burns, protect "leave" trees (above) and snags to the extent practicable[15]. Site preparation burns, when necessary before October 15, should be conducted after August 15 to prevent potential harm to young that are unable to fly.

j. The above-listed measures do not take the place of the other wildlife or sensitive species standards listed in the Forest Plan but are in addition to them.

k. The USFS will develop timber-marking guidelines for use by district personnel so as to insure that the specific terms and conditions of this Opinion are fully implemented.

l. The USFS will conduct and report the results of inspections of all timber sales on the Nantahala National Forest in Graham, Macon, Swain, and Cherokee Counties to ensure that the terms and conditions related to timber harvesting have been implemented, including a pre- and postharvest inventory of Indiana bat habitat components. For USFS timber sales, the contract administrator shall document pre- and postharvest monitoring, including any action taken through contract or law enforcement channels, to address negligent or willful damage to residual trees or riparian areas. The USFS will make these reports available to the Service, if requested.

2. To ensure landscape-scale effects are minimized, for nonlinear activities impacting forest stands of 5 or more acres, analyze the area for pre- and postproject conditions using the HSI (live 16-in. dbh potential roost trees, canopy cover, and dead 9-in. dbh potential roost trees) generated by the focal analysis described in Appendix D of the BA. Do not let any project or combination of projects decrease the HSI by more than 5% for the duration of this Opinion. If the HSI were to be decreased by more than 5%, consultation with the Service would be required.

3. All known roost trees will be protected until such time as they no longer serve as a roost (e.g., loss of exfoliating bark and/or cavities, blown down, or decay).

4. No standing[14] snags shall be removed during personal-use fuelwood cutting unless marked for removal[16].

5. When standing[14] snags need to be removed between April 15 and October 15 (other than those marked[16] as unsuitable) because they pose either a safety hazard or a project cannot be relocated, evening checks, mist-netting (per Indiana Bat Recovery Plan protocol), or mist-netting with the Anabat system for bat use shall be conducted by qualified personnel prior to removal. If no bats

are found, the tree may be removed after notifying the Service. If Indiana bats are found, consultation with the Service should be initiated. Note, however, that removal will be a last resort, after other alternatives (such as fencing the area) have been considered and determined to be unacceptable.

6. Any activities that involve modification of habitat or potential adverse disturbance between April 15 and October 15 within a 1.5-mi radius of known maternity sites shall be subject to further consultation.

7. The USFS will continue its Forest Plan monitoring efforts to determine use of the NPNFs by Indiana bats during the hibernation, summer roosting/maternity, and prehibernation seasons by implementing the following monitoring procedures. Selection of sites for future monitoring and surveys will be left to the discretion of USFS biologists. The Service believes that implementation of the following terms and conditions is necessary to evaluate the underlying assumptions made about Indiana bat presence and use of the NPNFs. Implementation of these terms and conditions will, in turn, provide a more site-specific measure of the protective adequacy of the Forest Plan's standards and guidelines and the terms and conditions of this Opinion for the Indiana bat on the NPNFs.

    a. Continue Forest Plan monitoring by working with the Service, universities, the North Carolina Wildlife Resources Commission, and local experts to locate and survey caves and mines that may contain Indiana bats. If Indiana bats are present, surveys shall continue biennially following the protocol of the Indiana Bat Recovery Team. If an Indiana bat hibernaculum is found on, or within 5 mi. of, the Nantahala or Pisgah National Forest, consultation with the Service shall be reinitiated. After any gating of a hibernaculum, biennial surveys shall be conducted to determine the effects of the gate(s) on all bat species.

    b. Continue monitoring efforts to refine the distribution and abundance of the Indiana bat on the NPNFs. Survey efforts should be focused on those areas which, based on habitat characteristics (e.g., percent canopy closure, presence of suitable roost trees, proximity to water, etc.) and/or previous survey results (e.g., Anabat detection), appear to be conducive to maternity colonies. These surveys should be designed to determine the distribution of the species on the NPNFs and its habitat use and movements of Indiana bats during the spring/fall periods. Comparative evaluations of the effectiveness of mist-netting surveys and Anabat detectors are strongly encouraged. If any Indiana bats (male or female) are netted, the Service must be notified within 24 hours. We recommend tracking them using radio-telemetry to identify and characterize roost trees and foraging habitat. The habitat at identified maternity sites will be characterized and quantified, and these habitat data will then be used to assist in identifying additional sites. Information gained during these studies can be used to refine USFS strategies for the protection and management of the species.

    c. Habitat at all sites where Indiana bats are documented on the NPNFs should be characterized and quantified at both local and landscape levels.

d. Upon completion of each survey, provide the results (within 6 months of survey/study completion) to the Service's Asheville, North Carolina, Field Office.

e. The amount of incidental take (both total and categorical levels, as measured indirectly by acreage) as identified in this Opinion must be monitored on an annual basis. This information is to be provided to the Service's Asheville, North Carolina, Field Office no later than 6 months following the end of the previous year's activities.

8. The NPNFs will consult with the Service on any plans to use *B.t.* or any other nonselective pesticide to control gypsy moth infestations or other forest pest insects. Reduction in nontarget lepidopteran abundance will be considered when developing spraying plans, especially when determining the size and configuration of spray blocks.

9. The above listed terms and conditions are only applicable in the forest types representing potentially suitable Indiana bat habitat (see Appendix D).

10. The above-listed terms and conditions do not apply to the removal of live, invasive exotic tree species; e.g., Tree of Heaven (*Ailanthus altissima*) and Princess tree (*Paulownia tomentosa*).
11. Care must be taken in handling dead specimens of Indiana bats (and any other species of bat) that are found in the project area to preserve biological material in the best possible state and to protect the handler from exposure to diseases, such as rabies. In conjunction with the preservation of any dead specimens, the finder has the responsibility to ensure that evidence intrinsic to determining the cause of death of the specimen is not unnecessarily disturbed. The reporting of dead specimens is required to enable the Service to determine if take is reached or exceeded and to ensure that the terms and conditions are appropriate and effective. Upon locating a dead, injured, or sick specimen of any endangered or threatened species, prompt notification must be made to the U.S. Fish and Wildlife Service, Southeast Region, Division of Law Enforcement, 1875 Century Blvd., Suite 380, Atlanta, Georgia 30345 (Telephone: 404/679-7057).

The Service believes that an indeterminate number of Indiana bats (as measured indirectly by the acreage presented in Table 15) will be incidentally taken as a result of the proposed action. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If during the course of the action the level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and a review of the reasonable and prudent measures provided. The USFS must immediately provide an explanation of the cause of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to use their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. The following conservation recommendations are discretionary agency activities to minimize or avoid

adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

1. Pursue additional funding and partnership opportunities to complete any additional inventory and monitoring work determined to be needed to better understand the autecology of the Indiana bat.

2. Where opportunities exist, work with landowners, the general public, and other agencies to promote education and information about endangered bats and their conservation.

3. The NPNFs hosts many visitors each year; therefore, the Service encourages the installation of informational/educational displays regarding all bats occurring on the NPNFs. The Service believes that such information would be invaluable in informing the public about the value of this misunderstood group of mammals. We also encourage the USFS to develop an educational slide program on the status of the Indiana bat and threats to its existence.

4. Provide training for appropriate NPNFs employees on the bats (including the Indiana bat) that occurs on the NPNFs. Training should include sections on bat identification, biology, habitat requirements, and sampling techniques (including instructions on applicability and effectiveness of using mist-netting surveys versus Anabat detectors to accurately determine the presence of various bat species). The proper training of NPNFs biologists on bat identification and reliable methods for counting roosting bats will enable the USFS to monitor the status of this species.

5. The demolition or removal of buildings or other manmade structures that harbor bats should occur while bats are hibernating. If public safety is threatened and the building must be removed while bats are present, a bat expert should examine the building to determine if Indiana bats are present; if so, consultation with the Service should be initiated.

6. Monitor percent canopy closure pre- and postharvest and the number of residual trees (i.e., snags, den trees, and live trees) per acre remaining on at least 10 final-harvest units and 10 partial-harvest units during the remainder of the Forest Plan (including some green units and some salvage units), and report these data to the Service. These data shall be collected within 3-6 months following harvest, and shall be reported to the Service within 3 months of collection.

7. Determine the longevity of snags, den trees, shagbark hickories (live and dead), and other live residual trees remaining within 10 final- and 10 partial-harvest units (including both green and salvage units) by monitoring the number within each category remaining per acre at intervals of 1, 3, 5, 7, and 10 years postharvest. For the purposes of this monitoring study, the same harvest units shall be monitored during each time interval. These data shall be reported to the Service within 3 months of collection.

8. Conduct any tree removal activities between October 15 and April 15, when possible.

9. Retain as many standing[14] damaged or dying[20] hardwood trees greater 9 in. dbh as practicable[15], but not less than three trees per acre (if present).

10. Avoid converting suitable Indiana bat forest type to unsuitable types.

11. Strive to control the spread of invasive exotic species; e.g., kudzu (*Pueraria lobata*), Tree of Heaven, and Princess tree, that result in the loss of suitable Indiana bat habitat.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, we request notification of the implementation of any conservation recommendations.

REINITIATION/CLOSING STATEMENT

This concludes formal consultation on the action outlined in your October 18, 1999, request for formal consultation. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this , (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this , or (4) a new species is listed or critical habitat is designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operation causing such take must cease, pending reinitiation.

Consultation should also be reinitiated if new biological information comes to light that invalidates the assumptions made regarding the biology or distribution (especially evidence of a maternity colony outside of Graham County, North Carolina) of the Indiana bat on the NPNFs.

Applicability of Biological Opinion to Site-specific Projects

The Service believes that the scope of effects for specific ongoing projects and projects developed through the continued implementation of the Forest Plan on the NPNFs falls under the umbrella of this consultation for the following reasons:

1. The reasonable and prudent measures outlined in this Opinion will minimize the impact of incidental take identified for the Indiana bat, on both a programmatic and site-specific level; accordingly, the protective measures outlined herein for Graham, Macon, Cherokee, and Swain Counties, North Carolina, are applicable to individual projects approved by the USFS hereafter.

[20] A dying tree is defined as having a broken or a damaged crown resulting in less than one-third of the original crown being intact and is not expected to survive.

2. If after complying with the Forest Plan's standards and guidelines and the terms and conditions associated with the reasonable and prudent measures provided in this Opinion, the USFS determines that activities on a project level are likely to adversely affect the Indiana bat in a manner or to an extent not considered or evaluated in the BA and this Opinion, further consultation will be necessary.

3. Any individual project that results or would result in incidental take that exceeds the level identified in this Opinion would require the reinitiation of formal consultation.

4. The USFS will continue to conduct site-specific project analyses to ensure that each individual action follows the recommendations set forth in this Opinion.

5. The Service will review site-specific projects, as appropriate, to ensure that there is strict adherence to the terms and conditions associated with the reasonable and prudent measures outlined in this Opinion and that incidental take levels identified in this Opinion are not exceeded.

If you or your staff have any questions concerning this , please contact Mr. Allen Ratzlaff of our staff at 828/258-3939, Ext. 229, or me, Ext. 223. We have assigned our Log No. 4-2-99-278 to this project; please refer to it in any future correspondence concerning this project.

Sincerely,

Brian P. Cole
State Supervisor

cc:
Mr. John Ramey, Forest Supervisor, U.S. Forest Service, National Forests in North Carolina, P.O. Box 2750, Asheville, NC 28802
Mr. Chris McGrath, Mountain Project Leader, North Carolina Wildlife Resources Commission, 315 Morgan Branch Road, Leicester, NC 28748
Regional Director, FWS, Atlanta, GA (PARD, Ecological Services, Attention: Mr. Joe Johnston)
Field Supervisor, FWS, Cookeville Field Office, Cookeville, TN

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------. 1999c. Letter to John Ramey, Forest Supervisor, from Brian Cole (signed by Acting State Supervisor Mark A. Cantrell), State Supervisor, Asheville Field Office, Asheville, NC. October 8, 1999. 3 pp.

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APPENDIX A

Standards and Guidelines - Nantahala and Pisgah National Forests

(From Biological Assessment)

Forest wide Standards

Page

Maintain viable populations of existing native and desired non-native vertebrate species in the planning area. Protect the following community types when identified as unique in the botanical or wildlife analysis: caves and rare plant communities, including bogs, rock cliffs, granitic domes, high elevation rocky summits, barren glades, balds, boulder field forests and seeps.

III-23

Provide site specific analysis of occurrence and effects on proposed, endangered, threatened, and sensitive species, and Forest-listed species at the project level. Provide aquatic, botanical, and wildlife analyses, biological assessment and/or biological evaluation as necessary to comply with the Endangered Species Act and FSM 2670. III-23

Assure a regular and sustained flow of habitats across the Forests through space and time for diversity and viability of plant and animal populations. III-29

The amount of 0-10 age class is regulated at 3 geographic scales: the analysis area, management area, and compartment (see pages III-29-31 for specific listing of 0-10 age class restrictions by MA).
III-29

Snags

Retain about 2 snags per acre during stand regeneration. Snags should be 15" dbh or greater, wherever possible. Retain bear dens, standing live and dead den trees of 22" dbh or greater, except where human safety is of concern. Favor snags along edge of openings or combined with other leave trees.
III-23

Old Growth

The desired future condition for old growth across the forest is to have a network of small, medium, and large sized old growth areas, representative of sites, elevation gradients, and landscapes found in the Southern Appalachians and on the Forests, that are well dispersed and interconnected by forested lands.

Large Patches: Evaluate the 30 large patches identified in Appendix K (Plan Amendment Appendix K) for future old growth management potential. Select 2500 contiguous acres or more within or proximate to each large patch. Identify two additional patches of at least 2500 acres,

one in the combined area of administrative watersheds 2, 3, and 4, and one in the combined area of the northwestern part of administrative watershed 26 and the northeastern part of administrative watershed 23, for old growth management. III-26

Medium Patches: In each administrative watershed containing more than 2500 acres of national forest land, and not containing a portion of a designated large patch area for old growth management, select a medium patch for future old growth management. III-27

Small Patches: In each compartment containing more than 250 acres of national forest land, select a small patch for future old growth management. If 5 percent of the compartment acres are already part of a large or medium patch, an additional small patch is not needed. Whenever possible, areas should incorporate some riparian habitat to enhance old growth values. III-27

Treatments allowed in areas managed for old growth: vegetative manipulation allowed for enhancement of old growth values and characteristics include:III-28

Downed logs in all stages of decay
Old trees
Standing snags undisturbed soils
Uneven-aged structure of canopy species
Single and multiple tree-fall gaps
Abundant fungal component
Large trees
Appropriate density and basal area of canopy trees

Salvage operations will not be allowed unless needed to protect the integrity of the old growth patch. III-28

Timber Management

Use rotations appropriate for the objectives of each MA. Use the following as minimum rotations for even-aged management: III-33

Upland hardwood - 80 years
Cove hardwood - 80 years

Vary sizes of even-aged and two-aged regeneration openings depending on MA directives. Limit the size of openings created by even-aged and two-aged regeneration harvest to 40 acres regardless of forest cover type with the following exceptions: -larger openings are the result of natural catastrophic conditions of fire, insect or disease attack, windstorm; or –the area does not meet the definition of created openings. III-34

Disperse planned regeneration openings to provide for wildlife habitat and vegetative diversity. Maintain a minimum of a manageable stand (at least 330 ft) between openings created by regeneration harvest except when using selection harvest methods. III-34

Establish a satisfactory stand on regeneration areas within 5 years after final harvest. Emphasize natural regeneration for hardwood forest types. III-35

Provide for stocking density and species variety through timber stand improvement practices. Encourage reproduction of oak, other hardmast and soft mast species by treating those stands where such seedlings or saplings are present to favor growth of these species and limit competition from other species. III-37

Manage to emphasize quality hardwood sawtimber as the primary product. Quality begins to occur when the following range of sizes is reached: III-61

Management Type	Product Size Range
Upland hardwoods	18-20 inches
Cove hardwoods	20-22 inches

Indiana Bat – No hibernacula for the Indiana Bat are known on the Forests. If one or more are found, the appropriate recovery objectives will be implemented.

1. Maintain, protect, and restore foraging and nursery habitat. Prevent adverse modification to foraging and nursery roost habitat.
   Determine habitat requirements.
   Preserve water quality.
   Restore and preserve forest cover along rivers and streams.
   Monitor habitat.
2. Implement the snag and den standard for areas considered suitable for commercial timber harvest in all project areas.
3. Maintain not less than 50 percent of the Forests in unsuitable timber management areas or in timber management areas where timber rotations are not less than 100 years, old growth, and/or riparian areas.
4. Maintain the integrity of mature and old growth habitats within riparian areas.
5. Where hibernacula are found, implement the protection and monitoring programs.

A-3

Minimum management requirements for diversity and viable populations of plants and animals.

L-48

Retain all standing live and dead den trees equal to or greater than 22”dbh in all management areas (MA’s) (including MA’s 1-5) except where public health and safety in a concern. L-48

Select old growth areas to represent the full range of forest community types occurring within the analysis area. Conduct the analysis at a landscape level. Consider wildlife corridors, rare species, spatial relationships and areas identified in the initial inventory of old growth. Use an interdisciplinary

team approach to select old growth areas. Riparian areas can contribute to old growth acreage only when they are included within a designated old growth area. Designate 5 percent or more per mile^2 or at least 50 acres per compartment for long-term old growth management. Select areas to represent community types in the general proportion to their availability in the analysis area. Areas selected should be at least 50 acres in size and generally 1000 ft or more in width. L-48

Retain two snags per acre in harvest units including uneven-aged harvest units. Coordinate snag retention in clear cut regeneration areas with visual quality and wildlife species objectives. L-48

Forest-wide Direction: An interdisciplinary team will conduct project-level and landscape-level analyses for proposed activities. Size of analysis area will correspond to appropriate management indicator species (MIS) or proposed, endangered, threatened, and sensitive species for the management area or aggregate of management areas, but will occur at the watershed level or in units of 5,000-15,000 acres, whichever is larger. L-48

<u>Management Areas Standards and Guidelines</u>

Management Area 2

Provide habitat conditions for pileated woodpecker, golden crowned kinglet, saw-whet owl, bats (roosting and foraging in habitats in mature forest), white-breasted nuthatch, and gray squirrel.

L-48

Standard: Provide not less than 5 percent and not more than 10 percent per compartment in 0-10 year age class. Configuration of 0-10 year stands in surrounding project/analysis areas are considered in the analysis. L-48

Management Area 2C – This land is unsuitable for timber production. The area will favor wildlife species that prefer older forest conditions and yet can tolerate some human disturbance.

III-63

Management Area 4

Provide habitat conditions for black bear, cerulean warbler, solitary vireo, veery, ovenbird, northern parula warbler, eastern wild turkey, pileated woodpecker, golden crowned kinglet, saw-whet owl, bats (roosting and foraging in habitats in mature forest), white-breasted nuthatch, and gray squirrel across the planning area by providing suitable habitat in MA 4. L-48

Standard: Provide not more than 10 percent per compartment in 0-10 year age class. Configuration of 0-10 year stands in surrounding project/analysis areas are considered in the analyses. L-4

The lands of MA 4 are managed to provide high levels of scenic quality, many opportunities for nonmotorized recreational uses and habitats for animals that prefer a predominance of older vegetation and limited disturbance. III-77

Management Area 4C – Emphasize visually pleasing scenery and habitats for wildlife requiring older forests. This land is unsuitable for timber production. III-77

Management Area 4D – Emphasize high quality habitats for wildlife requiring older forests. Allow small widely dispersed opening throughout the management area. III-78

Management Area 5

Provide habitat conditions for black bear, cerulean warbler, solitary vireo, veery, ovenbird, northern parula warbler, pileated woodpecker, golden crowned kinglet, saw-whet owl, bats (roosting and foraging in habitats in mature forest), white-breasted nuthatch, eastern wild turkey, and gray squirrel. L-49

Standard: Provide direct and indirect habitat improvements such as prescribed burning and small openings consistent with semi-primitive non-motorized recreational experiences and visual quality objectives. L-49

Emphasis is on providing large blocks of backcountry where there is little evidence of other humans or human activities other than recreational use. An unroaded forest environment and natural appearing forests with large old trees are desirable. Wildlife that benefit from old trees and greatly reduced disturbance from humans and motorized vehicles are favored on these lands. Timber production is not appropriate. III-89

Management Areas 6 and 7

Congressionally designated Wilderness Study Areas recommended for inclusion in the National Wilderness Preservation System. Manage to protect wilderness attributes. III-93/97

Management Area 13

These lands are special interest areas that are managed to protect, and where appropriate, foster public use and enjoyment of unique scenic, geological, botanical or zoological attributes.

III-144

Manage areas as land not selected for timber production. III-146

Management Area 14

This management area consists of the Appalachian Scenic Trail and its foreground zone.

Manage area as land not selected for timber production. III-161

Management Area 15

These are existing Wild and Scenic Rivers and adjacent lands that make up the river corridors.

Manage land not selected for timber production. III-170

Management Area 18

This Management Area consists of aquatic ecosystem, riparian ecosystem and closely associated plant and animal communities. The area will be actively managed to protect and enhance, where possible, the distinctive resource values and characteristics dependent on or associated with these systems. Timber management can only occur in this area if needed to maintain or enhance riparian habitat values. A high quality riparian area has a diverse assemblage of mature trees that can provide large woody debris for fisheries habitat and suitable conditions for late successional terrestrial plant and animal communities. III-179

Until identified, consider riparian areas as 100 ft (horizontal distance) on each side of a perennial stream or around a lake. III-181

Manage riparian areas as unsuitable for timber production during the 10-15 year period of the plan. Use vegetation management methods appropriate for land not suited for timber production.
III-186

Description of Management Practices for stand regeneration in Amendment Five E-1

Wildlife habitat needs such as snag and den tree requirements, outlined in the standard, must be followed in all phases of the selection of regeneration method. E-1

With the two-aged regeneration method, the residual overstory will remain in place until mid-rotation or later (40 years+). In many cases, it will remain until a new age class reaches rotation.
E-2

Leave trees with a wildlife objective should be mast producers, or provide den habitat. E-2

If only one entry is planned (two-aged shelterwood method) optimum regeneration would be achieved by establishing a residual basal area as low as 15-20 ft^2 per acre, depending on the average diameter of the residual trees. In order to meet wildlife or visual quality objectives, residual basal area will be higher, as much as 50 ft^2 per acre. E-2

Timber rotation by Management Area E-9

MA	Timber Type	Rotation Age

1B	Hardwood	80 years
2A	Hardwood	120 years
3B	Hardwood	80 years
4A,4D	Hardwood	120 years

Management Requirements and Mitigation Measures Required by the Record of Decision for Vegetation Management in the Appalachian Mountains

During timber stand improvements (TSI), wildlife stand improvements (WSI), and site preparation, selected groups of overstory and understory vegetation are protected and managed to assure a variety of softmast, hardmast, and cover species. During site preparation, active and potential den trees are retained in clumps (at least ½ acre per 20 acres) if they are not provided in adjacent stands not suitable for timber production, inclusions, or streamside management zones. During TSI and WSI, all recognized den trees are protected. In addition, during TSI, WSI, and site preparation, an average of at least two standing dead snags are retained per acre, in the form of large hardwood trees (greater than 12 inches) when possible. Appropriate treatments are used to create snags where snags are lacking. I-6

Wildlife Protection-burns are planned and executed to avoid damage to habitat of any threatened, endangered, proposed, or sensitive species. I-9

Protection of Threatened, Endangered, Proposed, and Sensitive Species (Herbicide Method of Treatment)

2,4-D, 2,4-DP, and triclopyr are not aerially applied within 300 ft, nor ground-applied within 60 ft, of known occupied gray, Virginia big-eared, or Indiana bat habitat.

Management Requirements for Control of Southern Pine Beetle

Insecticide will not be used in a manner that would adversely affect threatened or endangered species.

Riparian ecosystems that encompass floodplains and wetlands will receive appropriate protection. As a minimum, riparian areas will extend 100 ft from the edge of all perennial streams and other perennial water bodies, including lakes. J-2

APPENDIX B

Indiana Bat Life Table
(Estimated)

Age (x)	Survivorship (l_x)	Fecundity (m_x)	Realized ($l_x m_x$)	Age Weighted by Realized ($xl_x m_x$)	Expectation of Life (E_x)	Reproductive (v_x)
0	1.0000	0.000	0.000	0.000	2.993	8.73
1	0.5200	0.500	0.260	0.260	3.833	9.45
2	0.3947	0.500	0.197	0.395	3.733	8.85
3	0.2996	0.500	0.150	0.449	3.601	8.22
4	0.2274	0.500	0.114	0.455	3.427	7.55
5	0.1726	0.500	0.086	0.431	3.197	6.82
6	0.1310	0.500	0.065	0.393	2.895	6.07
7	0.0864	0.500	0.043	0.303	2.871	5.54
8	0.0571	0.500	0.029	0.228	2.835	5.01
9	0.0377	0.500	0.019	0.169	2.781	4.45
10	0.0249	0.500	0.012	0.124	2.698	3.87
11	0.0164	0.500	0.008	0.090	2.573	3.24
12	0.0108	0.500	0.005	0.065	2.383	2.55
13	0.0071	0.500	0.004	0.046	2.096	1.77
14	0.0047	0.500	0.002	0.033	1.660	0.83
15	0.0031	0.500	0.002	0.023	0.000	0.50
		7.5	0.9967	3.4656		
		(GRR)	(Ro)	(T)		

APPENDIX C

Priority Leave Tree Species List
for the Nantahala and Pisgah National Forests
in North Carolina

Class I Priority Leave Trees:

Carya laciniosa (shellbark hickory)
Carya ovata (shagbark hickory)
Carya cordiformis (bitternut hickory)
Fraxinus americana (white ash)
Quercus montana (chestnut oak)
Quercus rubra (red oak)
Quercus alba (white oak)
Robinia pseudoacacia (black locust)
Acer saccharum (sugar maple)
Betula spp. (birches)
Platanus occidentalis (sycamore)
Aesculus octandra (yellow buckeye)

Class II Priority Leave Trees:

Quercus stellata (post oak)
Acer rubrum (red maple)
Fagus grandifolia (American beech)
Nyssa sylvatica (black gum)
Quercus coccinea (scarlet oak)
Sassafras albidum (sassafras)
Pinus echinata (shortleaf pine >120 years old)
Pinus rigida (pitch pine >120 years old)

APPENDIX D

SUITABLE FOREST TYPES

CISC Code	Forest Type
White Pine-Hardwood Group	
8	Hemlock-Hardwood
9	White Pine-Cove Hardwood
10	White Pine-Upland Hardwood
Yellow Pine-Hardwood Group	
12	Shortleaf Pine-Oak
13	Loblolly Pine-Hardwood
15	Pitch Pine-Oak
16	Virginia Pine-Oak
20	Table Mountain Pine-Oak
49	Bear Oak-Southern Red
Cove Hardwood Group	
41	Cove Hardwoods-White
46	Bottomland Hardwood-Yellow
50	Yellow Poplar
55	Northern Red Oak
56	Yellow Poplar-White
Upland Hardwood Group	
42	Upland Hardwoods-White Pine
44	Southern Red Oak-Yellow Pine
45	Chestnut Oak-Scarlet
47	White Oak-Black Oak-Yellow
48	Northern Red
51	Post Oak-Black Oak
52	Chestnut Oak
53	White Oak-Northern Red
54	White Oak
57	Scrub Oak
59	Scarlet Oak
60	Chestnut Oak-Scarlet Oak
Northern Hardwood Group	
81	Sugar Maple-Beech-Yellow